APPLIED HYDRAULICS

AUGUST 1954

THE MAGAZINE OF FLUID POWER

INCLUDING AIR CONTROLS AND AIR CIRCUIT DESIGN • ELECTRICAL CONTROLS

This Month:

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Controlled Speed, Thrust and Torque . . . page 44

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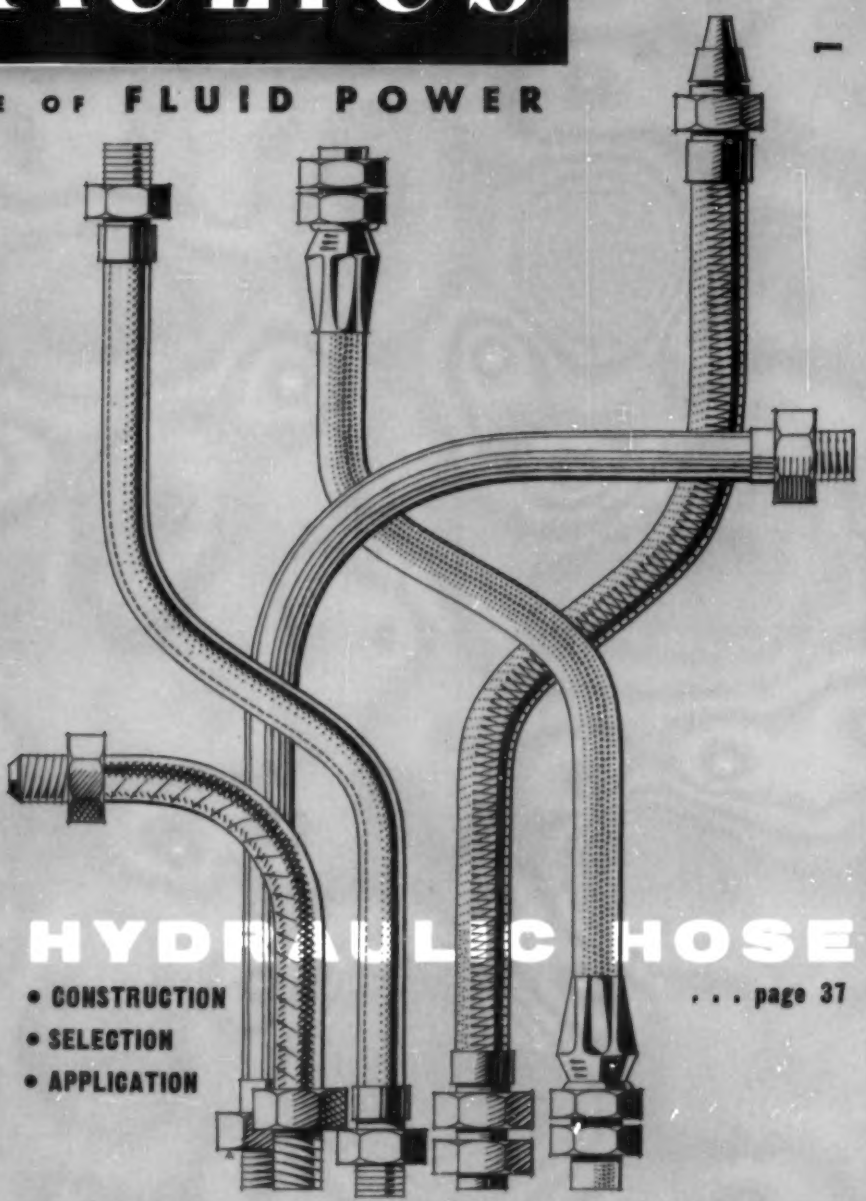

HYDRAULIC HOSE

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- CONSTRUCTION
- SELECTION
- APPLICATION

FRANCHISE CIRCULATION

HANSEN REPRESENTATIVES
Quick-Connective Couplings
Are Their Business
But So Are Fluid Line Problems

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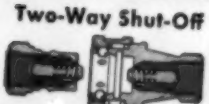

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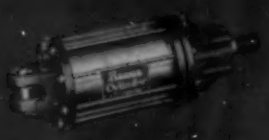

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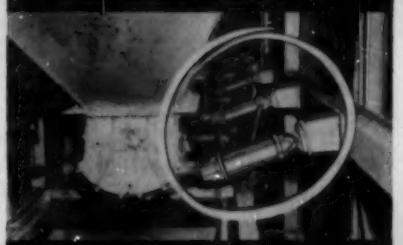

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AUGUST, 1954
Vol. 7, No. 8

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APPLIED HYDRAULICS

PNEUMATICS - HYDRAULICS - ELECTRICAL CONTROLS

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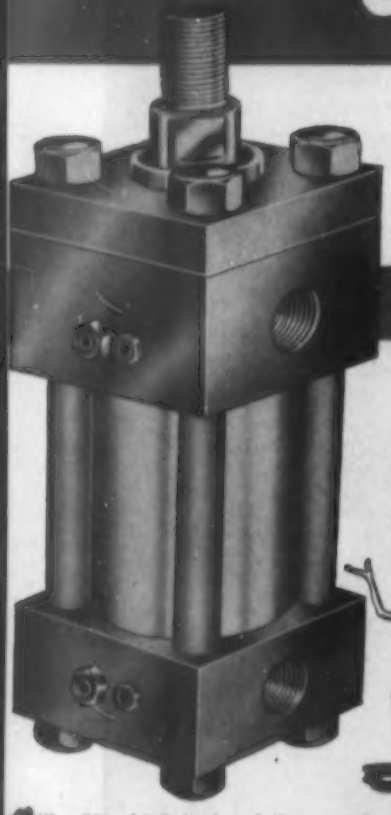

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			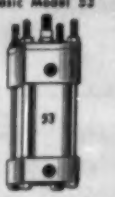			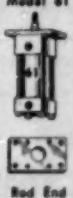				
			Tie Rod Mounting		Foot Mounting	Rod End Flange	Cap End Flange	Rod End Flange	Cap End Flange	Pivot Mounting
Bore	Stroke	Cushion	AIR A53	HYD. H53	AIR A61 A77	HYD. H61 H77	AIR A62	HYD. H62 H65	AIR A66	HYD. H66 H86
1½"	2"	Non		$ 58.50		$ 61.40		$ 66.70		$ 72.85
1½"	4"	Non		60.70		63.60		68.90		75.05
1½"	6"	Non		62.90		65.80		71.10		77.25
1½"	8"	Non		65.10		68.00		73.30		79.45
1½"	11"	Non		68.40		71.30		76.60		82.75
2"	2"	Non	$ 37.70		$ 39.75		$ 42.30		$ 44.60	
2"	4"	Non	39.40		41.45		44.00		46.30	
2"	6"	Non	41.10		43.15		45.70		48.00	
2"	8"	Non	42.80		44.85		47.40		49.70	
2"	11"	Non	45.35		47.40		49.95		52.25	
2"	3"	Both	62.05	94.50	64.10	97.45	66.65	103.05	68.95	111.55
2"	5"	Both	63.75	97.00	65.80	99.95	68.35	105.55	70.65	114.05
2"	7"	Both	65.45	99.50	67.50	102.45	70.05	108.05	72.35	116.55
2"	9"	Both	67.15	102.00	69.20	104.95	71.75	110.55	74.05	119.05
2"	13"	Both	70.55	107.00	72.60	109.95	75.15	115.55	77.45	124.05
2½"	2"	Non	41.45	73.30	43.70	76.25	46.25	82.30	49.00	93.10
2½"	4"	Non	43.35	76.00	45.60	78.95	48.15	85.00	50.90	95.80
2½"	6"	Non	45.25	78.70	47.50	81.65	50.05	87.70	52.80	98.50
2½"	8"	Non	47.15	81.40	49.40	84.35	51.95	90.40	54.70	101.20
2½"	11"	Non	50.00	85.45	52.25	88.40	54.80	94.45	57.55	105.25
3¼"	3"	Both	77.80	126.85	80.35	131.20	84.15	138.60	87.70	149.95
3¼"	5"	Both	79.80	129.85	82.35	134.20	86.15	141.60	89.70	152.95
3¼"	7"	Both	81.80	132.85	84.35	137.20	88.15	144.60	91.70	155.95
3¼"	9"	Both	83.80	135.85	86.35	140.20	90.15	147.60	93.70	158.95
3¼"	13"	Both	87.80	141.85	90.35	146.20	94.15	153.60	97.70	164.95
4"	2"	Non	56.25	106.00	59.10	111.15	62.95	118.90	67.30	132.80
4"	4"	Non	58.85	109.40	61.70	114.55	65.55	122.30	69.90	136.20
4"	6"	Non	61.45	112.80	64.30	117.95	68.15	125.70	72.50	139.60
4"	8"	Non	64.05	116.20	66.90	121.35	70.75	129.10	75.10	143.00
4"	11"	Non	67.95	121.30	70.80	126.45	74.65	134.20	79.00	148.10
5"	3"	Both	98.25		101.40		105.25		110.60	
5"	5"	Both	101.65		104.80		108.65		114.00	
5"	7"	Both	105.05		108.20		112.05		117.40	
5"	9"	Both	108.45		111.60		115.45		120.80	
5"	13"	Both	115.25		118.40		122.25		127.60	
6"	2"	Non	80.60		83.95		87.85		94.15	
6"	4"	Non	84.90		88.25		92.15		98.45	
6"	6"	Non	89.20		92.55		96.45		102.75	
6"	8"	Non	93.50		96.85		100.75		107.06	
6"	11"	Non	99.95		103.30		107.20		113.50	
8"	3"	Both	157.35		161.05		167.90		174.95	
8"	5"	Both	162.45		166.15		173.00		180.06	
8"	7"	Both	167.55		171.25		178.10		185.15	
8"	9"	Both	172.65		176.35		183.20		190.25	
8"	13"	Both	182.85		186.55		193.40		200.45	

Miller "Stock" Cylinders fully meet the J.I.C. Standards and are identical to Miller "Custom-Built" Cylinders in design and construction.

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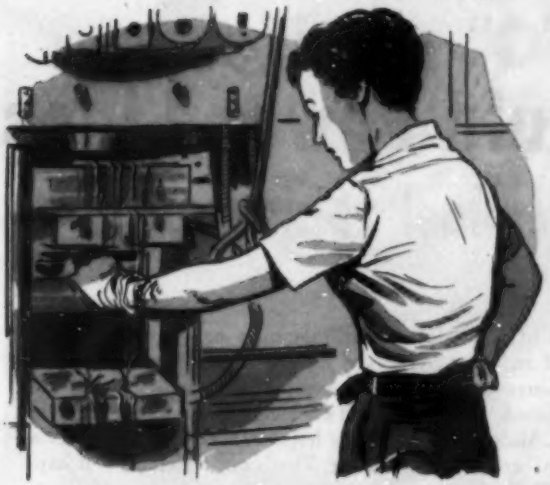

Hydraulic ram for injection molding press leaked excessively, using ordinary hydraulic oil. Make-up ran approximately 8 gallons per week.

Leaking oil dripped on hot platen and splashed onto operator, causing burns, spotted clothing, and generally untidy condition around the press.

Packings required changing at least once a month—frequent adjusting. Down time for maintenance seriously reduced productivity.

Changed to SUNTAC. Make-up oil now running only about ½ gallon per week. Operators are happier, and productivity greatly increased.

If you have a leaky hydraulic system, remember this: SUNTAC is the hydraulic oil especially compounded to reduce leakage. Special additives make the droplets cling together . . . keep them from leaking through packings. Experience has proved that SUNTAC will cut leakage an average of 35%. Get complete information about SUNTAC Hydraulic Oil from your Sun Oil Co. representative. Or write Dept. AH-8.

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APPLIED **HYDRAULICS**

Fluid Power Lines

"Hot" Atomics

Working with atomic materials has made it necessary to develop handling devices which can be controlled by a man located at a safe distance from the radiating workpiece. A "safe distance" usually requires a barrier between the operator and the work. This means that pushbutton control of handling devices has had to be supplied. Oil powered devices have been readily adapted for these applications. Cylinder operated handling tools are powerful and reliable. In this month's lead article, Charles M. George tells about some of the hydraulic equipment used at the Los Alamos Scientific Laboratory.

A Strong Link . . .

. . . in your hydraulic system is the hydraulic hose. Recent developments have made hose very reliable for use on oil systems having pressures well over 3000 psi. In this issue, J. A. Muller presents material on the construction, selection and application of hose on hydraulic systems.

How to Quiet a Pump

With oil power being applied more widely on aircraft and automobiles, noise reduction has obtained greater consideration. To the uninitiated passenger in the plane or car, any sudden noise resulting from hydraulic system operation, at the very least, reduces comfort. Because much of this noise is inherent in pump design, investigation of the source of noise has led to methods of its elimination.

This month, Part 1 of a two part article on methods of reducing hydraulic noise in positive displacement pumps is published. The author is Professor E. L. Midgette who heads the mechanical engineering department at Polytechnic Institute of Brooklyn. You'll find Mr. Midgette's articles to be extremely practical. They are based on development work carried out to solve problems relating to the use of industrial hydraulic equipment.

No Limitations, Please!

You can ask politely or any other way but there will still be limitations placed on any design. Fortunately, designers keep whittling away at limitations to make their machines more and more useful. A typical example of a press design which is adaptable to a wide variety of stamping and extrusion operations is described on page 35. Designers of this press literally turned the conventional design upside-down and found many limitations which existed before could be overcome.

"Clean oil is the answer . . .

. . . to most of your troubles with hydraulic equipment." That's what a recent survey proved. Dirt in the hydraulic system is the cause of more downtime and repair cost than all other causes added together. How can dirt be eliminated? The answer of course is: FILTERS. However, having a filter on the machine is not enough by itself. First, the filter must be the right size and must be properly located. Second, the filter must be serviced. A clogged filter is worse than none at all. Some machine operators realize this and obligingly use a screw driver to poke holes in a dirt blocked suction filter. That's not farfetched—it happens.

Location of the filter in the hydraulic circuit is the subject of an article in this issue. Each machine has different requirements—it pays to be familiar with the possible filter arrangements, their advantages and limitations.

10th Annual NCIH

On October 14 and 15, the 10th annual National Conference on Industrial Hydraulics will be held at the Hotel Sheraton in Chicago. From the partial program, which is announced on page 48, you'll get a preview of the excellent papers which are being prepared. This year, for the first time, there will be papers discussing pneumatic systems.

And in September . . .

Articles in the September issue will supply answers to a number of everyday fluid power problems. Here is a sample. . . What circuit should be used to change machine slide motion from rapid advance to feed? Ed Gatwood of Vickers will answer this one. Jim Tankard will analyze basic differential circuits. Another solution to a difficult job of getting cylinders to move together will be presented by Arthur Lassman. Use of an air-operated pump will be detailed by George Becker, Allis-Chalmers product engineer.

Precision "O" Rings make these Quick-Connect couplings leak-proof!

Hydraulic, pneumatic and other fluid lines can be connected or disconnected quickly, easily and safely with the two-way shut-off couplings made by **The Hansen Manufacturing Company** of Cleveland. When connected the Hansen coupling permits a free flow through it—and a **Precision "O" Ring** makes the vital seal which insures a long life of leak-proof service.

Everywhere **Precision "O" Rings** are doing a big job, carefully inspected, high quality, tough, compression molded, they lick leakage! Let us help you.

FREE—Write for your personal copy of our Handbook on "O" Rings.

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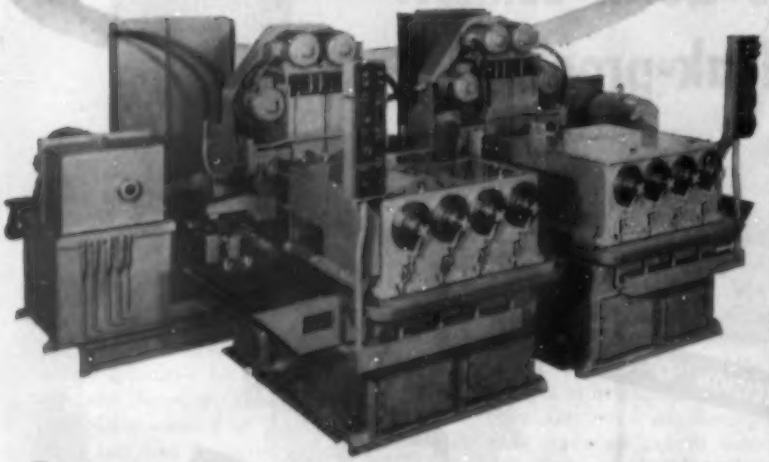
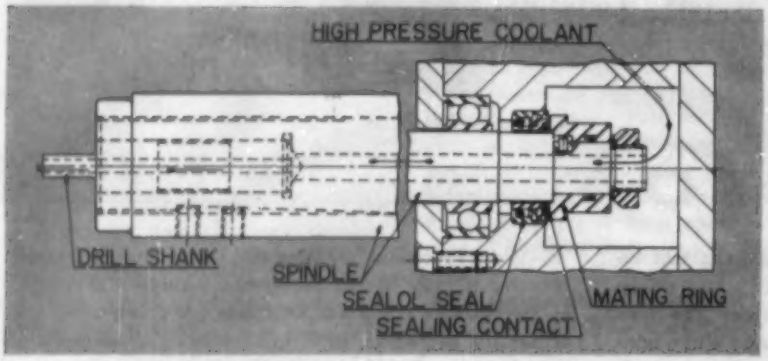
CORPORATION
"O" Ring and Dyna-seal Specialists

Dept. 1, Oakridge Drive, Dayton 7, Ohio **Canadian Plant at: Ste. Thérèse de Blainville, Québec**

How the SEALOL Seal solved a machine design problem . . .



This Krueger-Barnes gun drilling machine is designed for drilling accurate holes to extreme depths. The problem in the gun drilling operation is to get coolant under great pressure to the point of the drill, for cooling, for lubrication, and for chip removal . . . and Sealol helps solve the problem.



The sketch shows the Sealol Seal which makes it possible to keep the coolant flowing to the gun drill under pressures as high as 1,000 psi. Sealol's engineering staff worked in close cooperation with Krueger-Barnes Corporation, adapting proven Sealol mechanical shaft sealing designs to the special conditions of the gun drilling operation.

This designed-in seal is typical of the high-capacity performance obtainable with Sealol Seals. May we help with your shaft sealing problems? Send job description, or write for Bulletin 7 — the complete story on Sealol Balanced Pressure Seals. Sealol Corporation, 9 Willard Avenue, Providence 5, R. I.

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THE BALANCED PRESSURE SEAL

LETTERS to the Editor

Where Are They?

We would appreciate it if you can supply us with the correct address of Salscor Company.

R. W. SILLMAN,
Service Manager,
H. L. Peterson, Inc.

The Salsbury Corporation (Salscor Company is the sales subsidiary) is located at Salsbury Bldg., 1161 E. Florence Ave., Los Angeles 1, Calif.

Market Survey Organizations

Could you suggest a competent organization that could make a market survey in the field of high pressure hydraulic equipment.

P. W. MEYER,
Defense Engineering Dept.,
Bigelow-Sanford Carpet Co., Inc.

There are two organizations which include members who would be in a position to make a competent, professional caliber market study for you. We suggest you get in touch with one or both of the following: Association of Consulting Management Engineers, Inc., 347 Madison Ave., New York 17, N. Y.; American Institute of Consulting Engineers, Inc., Suite 401, Engineering Societies Bldg., 33 West 39th St., New York 18, N. Y. Both of these organizations publish directories of member companies which list types of services offered.

NCIH Papers

We understand from APPLIED HYDRAULICS that the following papers were read at the ninth National Conference on Industrial Hydraulics: "Friction and Wear Phenomena"; "Hydraulic Problems on Large Forging Presses"; "Factors in Design of Mechanical Seals and Applications to Hydraulic Equipment"; and "The Effect of Syn-

Continued on page 12

When it's high pressure... it's AMERICAN!

For variable pressures up to 3000 p.s.i. . . .

HELE-SHAW

THE FAMOUS HELE-SHAW is a radial-piston variable displacement fluid power generator. It is remarkably easy to apply to the machine it serves . . . may be installed on or near the machine, remote from it, or incorporated as an integral part of the design.

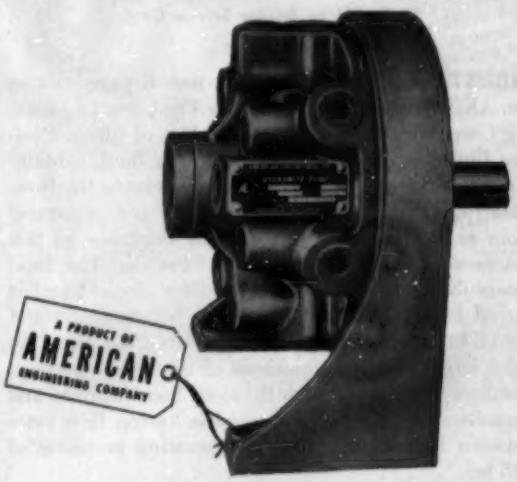
In the Hele-Shaw pump, pressure and reversal of flow are controlled directly at the pump. Discharge is infinitely variable from zero to maximum . . . and can be reversed instantaneously or gradually. Capacities range from 3⅜ to 50 g.p.m. and upward.

For pressures up to 5000 p.s.i. . . .

HYDRAMITE

THE HYDRAMITE is a radically new radial-piston constant displacement fluid power generator . . . has an overall efficiency of 85% without supercharging. Direct-driven through a flexible coupling, Hydramite rotates in either direction . . . can be foot, flange or face mounted. It is available in 3, 5, and 10 g.p.m. oil capacities.

Products of American Engineering Company, the Hele-Shaw and Hydramite Pumps are outstanding in their respective high pressure ranges . . . bringing users top efficiency and economy on a vast and growing variety of hydraulically-operated equipment. Mail coupon for full information.



AE

AMERICAN ENGINEERING COMPANY

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AE Products include: Hydramite and Hele-Shaw Fluid Power, Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Lo-Hed Hoists, Lo-Hed Car Pullers

American Engineering Company
2530 Aramingo Avenue, Philadelphia 25, Pa.

Gentlemen: ☐ Kindly send me complete information about the new HYDRAMITE. ☐ Hele-Shaw.

Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

USEFUL LITERATURE

You'll find many valuable production and design ideas in publications described here . . . copies will be sent you free without obligation

PLASTIC CAPS AND PLUGS . . . for threads, pipe and tubing ends, are used as shipping protectors and seals against dust and moisture. A 12 page booklet has been released by CaPlugs, Division of Protective Closures Co., Inc. These pieces are designed so that standard sizes will fit any diameter, as caps or as plugs, inside or outside, threaded or plain, from ⅛ in to 1½ in, special sizes are available up to 3½ in. They are impervious to all common chemical reagents, such as solvents, sterilizing agents, caustic and acid baths, and will keep their shape to about 220 F. Tables are included which show all dimensions for the various types. Other products included are caps for electrical connectors, threaded plugs for aircraft and hydraulic tube fittings, flange protector caps and sleeve caps for tubing.

Circle 151 on Reader Service Card

INDUSTRIAL FILTERS . . . A new 8 page catalog No. AK050 has been published by The Cuno Engineering Corp. which describes the full line of filters. Positive filtration is obtained by passing a fluid, containing solids, between discs, placed edgewise to the flow. These discs are on a center support rod, separated from each other by a spacer. The thickness of this spacer determines the degree of filtration. The fluid enters the space surrounding the filter element and is forced by the differential pressure between inlet and outlet, to pass through the slots between the discs. No solid larger than the thickness of the spacer between the discs can pass through the slots. Specifications and capacities are given for all models having flow rates between 1 and 3760 gpm and operating pressures of 125 psi.

Circle 152 on Reader Service Card

SOLENOID VALVES . . . for oil and air operation are designed for pressures to 5000 psi at 150 F and 2500 psi at 450 F. Bulletin HP201, released by Atkomatic Valve Company, Inc., illustrates features of the high pressure pilot operated and direct lift solenoid valves, with diagrams of electrical circuits used for normally open, and normally closed operations. Bodies, piston and component parts are bronze; the spring, pilot valve assembly and seat are stainless steel. Pipe sizes ⅛ in to ¼ in are direct lift, with moving armature, and sizes ½ in to 1½ in are globe type, pilot operated. A cross sectional drawing shows the construction of the valve. A table shows for each pipe size, the orifice, psi, temperature and material.

Circle 153 on Reader Service Card

SOLENOID PILOT OPERATED VALVE . . . An air-control valve built to meet J.I.C. standards is described in Valvair bulletin SKJ-54. The valve has speeds up to 600 cycles per minute and with a life well beyond the 20,000,000 mark. The unit is totally enclosed and will operate under water. The design is simple, having only two moving parts; a single spool type stem in the main valve body and the plunger in the pilot. No springs are used in the main valve, since air positions the stem in both directions. A manual over-ride enables the valve to be operated without current. Recommended pressures are from 35 to 200 psi for air and low pressure hydraulics. Available in 2-way, 3-way, 4-way and 4-way-5-port models with either fast mounting or sub-base manifold mounting in the 3-way and 4-way valves.

Circle 154 on Reader Service Card

ENCLOSED WIRING BOXES . . . manufactured to J.I.C. standards are described in literature available from Hoffman Engineering Corporation. Protection to electrical equipment and wiring is assured as the boxes are oil and dust tight. There are no knockouts or holes. Relays and timers can be mounted in the box, as the box is equipped with a removable panel for this purpose. All dimensions are included for the various models which are available, showing box and panel size, mounting holes and overall dimensions.

Circle 155 on Reader Service Card

DIAL THERMOMETERS . . . for many different uses, are presented in an 8 page bulletin, Form DT-1-54, published by Rochester Manufacturing Company, Inc. Industrial, laboratory, heavy duty industrial, heavy duty for petroleum and chemical service, and straight form thermometers are all discussed. The features of each type, a complete description of the dial assembly, immersion depth, accuracy and range are included. All dials are non-fogging and are hermetically sealed.

Circle 156 on Reader Service Card

For more reviews of Free Literature turn to page 102

Circle 29 on Reader Service Card

Advertising like this is a constant reminder to Engineers and Designers to specify . . . . Eastman *first in the field*

HYDRAULIC HOSE ASSEMBLIES

Stop torsional strain with Eastman ADAPTER UNIONS

Eastman Design and Engineering Guarantees Tight Fit . . . Easy Action

- **Eastman Adapter Unions** prevent twisting and assure proper positioning of hose lines when being installed. Accurate machining assures leakproof metal-to-metal seat as effective as a ground joint union.
- **Eastman Angled Adapter Unions** eliminate the use of elbows and pipe unions, thereby reducing the number of threaded connections. Original Eastman design provides tight-fitting joint at any pressure.
- **Eastman, "First in the Field of Hydraulic Hose Assemblies,"** stands for the highest quality of material and workmanship—your best assurance of satisfactory service.

"Safeguarding Industry's Lifelines of Mobile Power"

Straight and Angled Adapter Unions

EASTMAN MANUFACTURING CO.
Since 1914
Dept. AH8, Manitowoc, Wisconsin

Eastman *first in the field*
HYDRAULIC HOSE ASSEMBLIES

Send for Eastman Form No. 231-B, 232-B for sizes, angles available.

Specify Eastman HYDRAULIC HOSE ASSEMBLIES

- Profit from Eastman's 26 years' experience in Hydraulic Hose Assemblies. Pressed-on, re-usable and renewable couplings and insert type fittings for high and low pressure air, gas, water, paint, grease and hydraulic hose . . . from ⅛" to 2". Pressure lines up to 5000 psi. Also suction and low pressure units.

WRITE FOR COMPLETE CATALOG OR PHONE YOUR SPECIFICATIONS

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HYDRAULIC HOSE ASSEMBLIES

SAFEGUARDING INDUSTRY'S *Lifelines of Mobile Power*

Write for free catalog 104 on Eastman Hose Couplings and Bulletins 231B & 232B on Straight and Angled Adapter Unions.

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Since 1914
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GARLOCK Service-Tested
LEATHER PACKINGS

Available in ALL SHAPES, ALL SIZES, ALL TANNAGES and ALL TREATMENTS

GARLOCK's modern, completely equipped leather packing manufacturing plant has the facilities to furnish *all types* of leather packings. This plant maintains the same high standards of materials, design, workmanship, and inspection that Garlock has upheld for the past 66 years in the manufacture of mechanical packings.

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Molded Cups **"U" Packings** **"V" Packings** **Washers** **Gaskets** **Discs** **Flange or Hat Packings**

SIZES

All sizes suitable for leather packing applications from ⅛" O.D. (such as leather washers for needle valves) to 90" O.D. (such as large "U" packings for heavy duty hydraulic service).

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Oak **Chrome** **BITAN®**

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Oil, grease, or wax treated (and combinations of these impregnants)—in degrees of hardness from extremely soft and flexible to very hard and rigid.

Synthetic rubber impregnated—combines the high tensile strength of leather and elasticity of rubber, and gives greater temperature resistance.

With fabric liners.

Untreated—for certain low pressure water applications.

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GARLOCK

PACKINGS, GASKETS, OIL SEALS
MECHANICAL SEALS
RUBBER EXPANSION JOINTS

Letters to the Editor

Continued

thetic Fluids on Hydraulic Components and Circuits".

C. F. CARPENTER,
Industrial Consultant

All the papers you name as well as the complete text of other papers on the program of the ninth NCIH have been published in the "Proceedings" of the Conference, bound copies of which are available from the NCIH Secretary, Illinois Institute of Technology, Technology Center, Chicago 16, Ill. at $4.50 per copy.

Design of Central Hydraulic Systems

Following is an excerpt from a letter written to William W. Lytle, president, Lytle Engineering Co. and refers to Mr. Lytle's article, "A New Approach to the Design of Central Hydraulic Systems" which appeared in the May, 1954 issue (pp 72-75, 96)

We have read your article in the May issue of APPLIED HYDRAULICS magazine and wish to compliment you on the complete and informative treatment on the design of central hydraulic systems. As you probably know, we are primarily manufacturers of high pressure pneumatic equipment for aircraft and we have a good deal to learn about the application of high pressure pneumatics and hydraulics to industrial usage. Your article has helped clear up many of the questions we had regarding this subject.

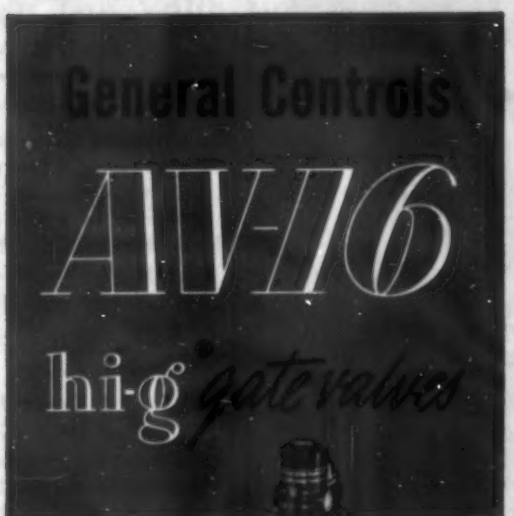
It appears that the availability of reliable and inexpensive high pressure air compressors, specially designed for industrial use, may someday entirely eliminate the necessity for central hydraulic systems entailing long, high and low pressure and return lines, together with valves, elbows, tees and other fittings. It seems just as logical and desirable as the elimination of line shafts with pulleys and belts, a power source outmoded in industry many years ago.

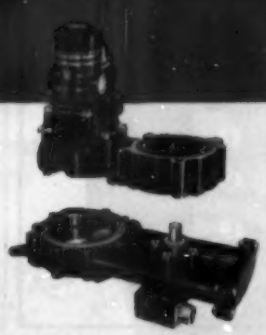
In your letter of May 12, you state that you do not advocate using air directly loaded on oil where

Continued on page 14

dependable shut-off control ...in 7 sizes

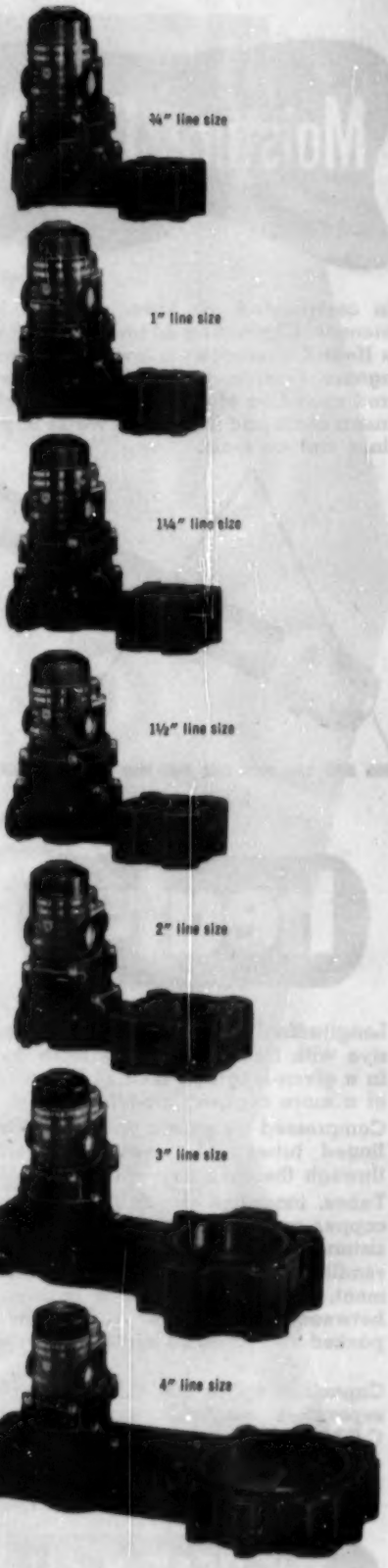
AV-16 series gate valves are manufactured by General Controls in seven convenient sizes for high volume flow control of fuel, air, oil or other fluids. A powerful motor, DC or 400 cycles, and an instantaneous, positive drive clutch insure dependable operation. "O" ring flange seals and a one-piece body casting simplify installation and prevent leakage. Thermal relief, manual override, position indication and radio noise filters are furnished as optional equipment. Larger sizes and special pressure and temperature ratings available on special order. Write for Catalog 53A.





Pull-out (bolt-through) models of the AV-16 series are available in 1", 1¼" and 2" tube sizes.

Manually operated versions with or without electric position indicator are available in all seven sizes.



GENERAL CONTROLS

Plants in: Glendale, Calif., Burbank, Calif., Skokie, Ill.
Factory Branches in 37 Principal Cities
SEE YOUR CLASSIFIED TELEPHONE DIRECTORY

Manufacturers of Automatic Pressure, Temperature, Level and Flow Controls for Heating, Home Appliances, Refrigeration, Industrial and Aircraft Applications.

Moisture Can Mean Trouble

In compressed air lines, moisture is a menace. Eliminating oil and moisture with a Heat-X aftercooler is low cost insurance against receiver tank explosions, rusting and corroding of pipe lines, fouling of air instruments and freezing of water in pipelines and air tools.

heat-x

Longitudinal inner-fin construction, exclusive with Heat-X, produces more cooling in a given length of tube . . . permits use of a more compact model.

Compressed air passes through the inner-finned tubes . . . water counterflows through the shell over the tubes.

Tubes, inner-fins and tube sheets are of copper and brass for high corrosion resistance and long life. Tube bundle is readily removable for cleaning or replacement. "O" rings provide a positive seal between air and water . . . eliminate all packed and soldered joints and gaskets.

Capacities up to 500 C.F.M. Companion separators available from 100 to 500 C.F.M.

WRITE FOR FREE ILLUSTRATED BULLETINS.

INNER-FIN IS A PATENTED HEAT-X DEVELOPMENT.

THE HEAT-X-CHANGER CO., Inc.

BREWSTER - NEW YORK

Letters to the Editor

Continued

working pressures are over 300 psi. We presume that the reason for this statement lies in the possibility, supported by popular opinion only, that explosion dangers exist where oil and air over 300 psi come into contact. Military aircraft for years have used air at pressures up to 3000 psi for pressurizing landing struts and accumulators. Impact loading, which occurs in the struts during takeoff and landing probably is frequently in excess of 4500 psi and while these are, of course, piston type struts, the cylinder surfaces are constantly wetted with the hydraulic fluid. It is our opinion that danger of air-oil explosion, even at pressures up to 3000 psi, is non-existant, even when inflammable hydraulic fluids are used. Certainly in the case of an oil-water emulsion type of fluid using a water soluble oil, no explosion would occur.

FRED W. MOHL,
Assistant Sales Manager,
The Cornelius Company

Mr. Lytle, in his answer to Mr. Mohl, states: "I agree with Mr. Mohl in his conclusions as to the possibility of maintaining high pressure air in direct contact with oil. My statement can, of course, be taken as a personal opinion and not as a fact."

A Correction

On page 44 of your June issue you listed the Stainless Steel Tube Institute at the Gulf Bldg., Pittsburgh, Pa. We have been unable to locate this organization at that number. Will you give us the correct address?

RONALD L. FEEST,
Formrite Tube Co.

On checking our records we find that the name should have read Seamless Steel Tube Institute, Gulf Bldg., Pittsburgh. We do not know of a stainless steel tube institute. The most complete piece of technical literature available on stainless steel is Bulletin No. 3 "Stainless Pipe and Tubes", published by National Tube Division, United States Steel Company, 525 William Penn Place, Pittsburgh, Pa.

Continued on page 18

RACINE

HYDRAULIC POWER PLANTS

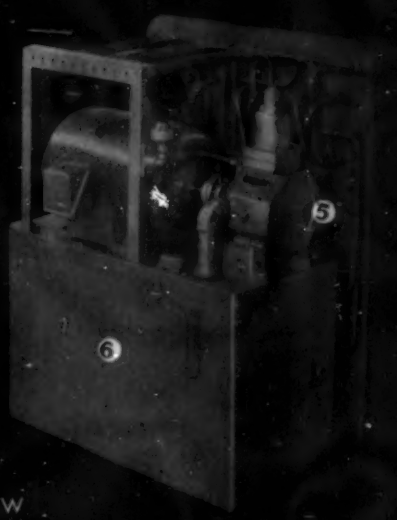
A RACINE packaged Power Unit offers you maximum flexibility in operation and performance. It comes complete, ready for immediate installation on your equipment.

The heart of this system, a RACINE Variable Volume Pump, conserves horsepower by putting all of the oil to work. Relief and By-pass Valves with extra piping are unnecessary.

DESIGNED FOR YOUR NEEDS

These package units can be designed to meet your space and circuit requirements. All components are centrally located with the Control Valves positioned on an easily accessible control panel. Investigate the possibilities as applied to your products. Write for complete RACINE Hydraulic Catalog and the name of your nearest RACINE Field Office offering a complete engineering service.

FRONT VIEW



REAR VIEW

1
2
3
4
5
6

"They Work Better Together"

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RACINE

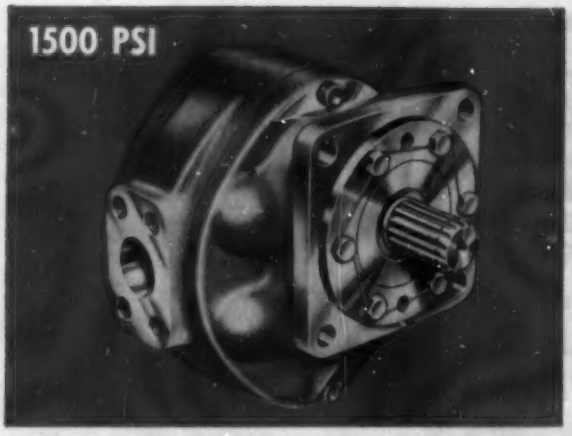
FOUR...

COMPLETELY NEW LINES OF HYDRAULIC PUMPS WHICH GIVE YOU FAR MORE IN PERFORMANCE AT FAR LESS IN COST!

- Pumps to give new life to existing equipment . . . to improve performance, increase capacity!
- Pumps that afford the design engineer the basic equipment for entirely new concepts in hydraulically operated machines!
- Pumps for machines to do work better, quicker, cheaper!

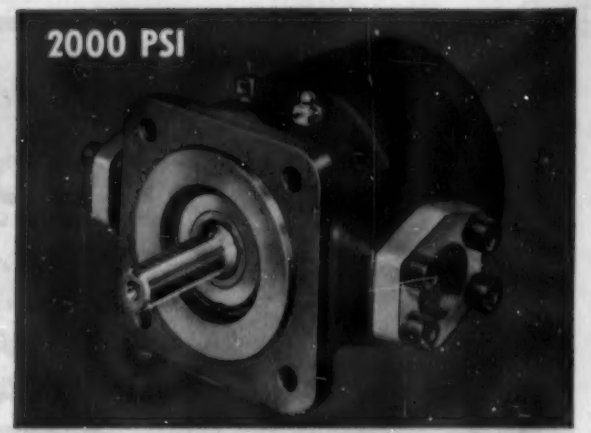
THE NEW YORK AIR BRAKE COMPANY

1104 East 222nd Street • Cleveland 17, Ohio



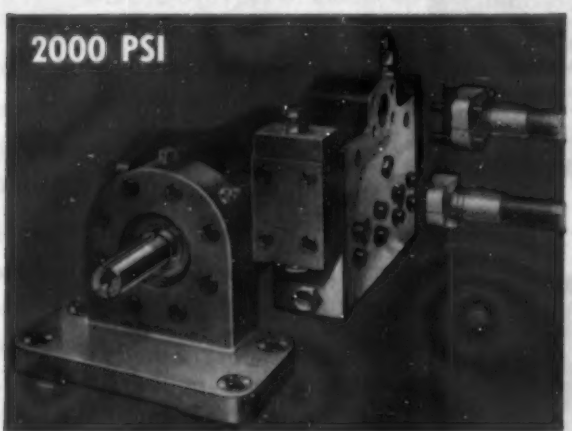
SERIES H GEAR-TYPE PUMPS

The HYDRECO Series H Pumps are intended for use in the hydraulic systems of heavy-duty mobile and industrial equipment, especially where shock loads, impact and rugged service are "normal working conditions". Four sizes (40, 50, 60, 70 gpm) deliver fluid power at 1500 psi . . . increased horsepower gives greater work output. *Pressure-Balanced* wear plates reduce oil slippage and eliminate power-robbing frictional contacts. SAE Flange Mounting and split-flange hose connections make servicing simple and reduce down-time. Equipment is on-the-job longer.



SERIES PF-100 VANE-TYPE PUMPS

DUDCO PF-100 Series Pumps can double the value of your *hydraulic dollar*. You get 2000 psi continuous duty, single-stage construction for the cost of equal capacity low pressure pumps . . . improved equipment design and increased machine efficiency without the payment of premium prices. These Pumps feature a simplified, 3-unit construction . . . the pumping cartridge incorporates the famous DUAL-VANE design which provides and assures complete balance of all hydraulic pressure loads. These Pumps have capacities of 3, 5, 8 and 11 gpm at 1200 rpm.



SERIES PF-100 DOUBLE PUMPS WITH VALVE PANELS

DUDCO PF-100 Series Double Pumps with Valve Panels are versatile units unmatched as a source of *Controlled Fluid Power* for a wide variety of modern industrial equipment . . . for 2000 psi operation of circuits calling for a substantial variation in pump volume as during "close and hold" or "traverse and feed" cycles. The Valve Panel contains the valving necessary for pressure regulation and flow control . . . the external part of a system will have less valves and controls, reduced piping and fewer parts to maintain. Ten capacity combinations with either automatic or remotely controlled operation.

SERIES PV-600 PISTON-TYPE PUMPS

DUDCO PV-600 Series Variable Delivery Pumps generate continuous duty pressures up to 5000 psi. Two types of controls match pump output to system demands. A pressure-compensated regulator automatically varies the volume in response to system pressure. A hand wheel control enables an operator to vary the volume during the machine cycle. High pressure variable delivery means power is transmitted without the necessity for an accumulator and without any wastage of power thru a relief valve.

WRITE TODAY . . .

Get full particulars on these important new developments in hydraulic pumps!

The New York Air Brake Company
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Please send details on

- ☐ SERIES PF-100 VANE-TYPE PUMPS
- ☐ SERIES H GEAR-TYPE PUMPS
- ☐ SERIES PF-100 DOUBLE PUMPS WITH VALVE PANELS
- ☐ SERIES PV-600 PISTON-TYPE PUMPS

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Address_____

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LIFT

the efficiency of your hydraulic unit with Roper dependable Pumps. Get optimum performance from the pumps that feature just two moving parts — equal size gears operating in a sturdy case with proper clearance for superior service and long life. The models shown are representative of standard Roper pumps suitable for most applications.

Specify
ROPER
Rotary Pumps
FOR YOUR
HYDRAULIC APPLICATIONS

LOWER

maintenance costs with a Roper. For instance, a pump like the Series H with pressures to 1000 P.S.I., sizes 10 to 75 G.P.M. is ideally suited for hydraulic mechanisms and for other applications requiring high pressures. Spur gears run in axial hydraulic balance . . . bearings and bronze wear plates reduce friction under heavy loads. Available with packed box or mechanical seal.

PUSH

the unit in your hydraulic circuit with the correct size Roper for the particular job. In many cases the Series K will do, for it is rated from pressures to 150 P.S.I., capacities ⅛ to 80 G.P.M. This model is compact, sturdy . . . is self-lubricated by liquid pumped . . . handles total suction lifts up to 25 feet. Comes with packed box or mechanical seal . . . with or without relief valve.

ROPER Rotary Pumps

GEO. D. ROPER CORPORATION
708 Blackhawk Park Ave., Rockford, Illinois

PULL

favorable comment on a wise choice when you install a Roper as original equipment. Among the dependable Ropers is the Series F Pump — pressures to 300 P.S.I., sizes 1 to 300 G.P.M. It features four-port design with 8 optional piping arrangements . . . supplied in standard or stainless steel fitted models. With packed box or mechanical seal; with or without relief valve.

Letters to the Editor

Continued

"Beginners Course in Basic Pneumatics"

We are glad to learn that the pneumatic series, "Beginners Course in Basic Pneumatics" will be reprinted in booklet form. We shall appreciate your advising us when the booklet will be ready and what the price will be.

EARL J. KANE,
Chief Tool Designer,
Sangamo Electric Company

The reprint booklet, "Beginners Course in Basic Pneumatics" is now in preparation and should be ready for distribution late in August or early in September. Single copies will sell for $1.00. A rate for multiple copies will be announced when the booklet is ready. We will accept reservations for copies now.

Credit Line

In the article, "Bonded Seals . . . How and Where to Use Them" which ran in the May issue (pages 69-71, 98) the credit line for Figure 7, page 71 was omitted. The valve photograph should have carried the following line, "Courtesy Towler Brothers (Patents) Ltd."

Back-to-Back Articles

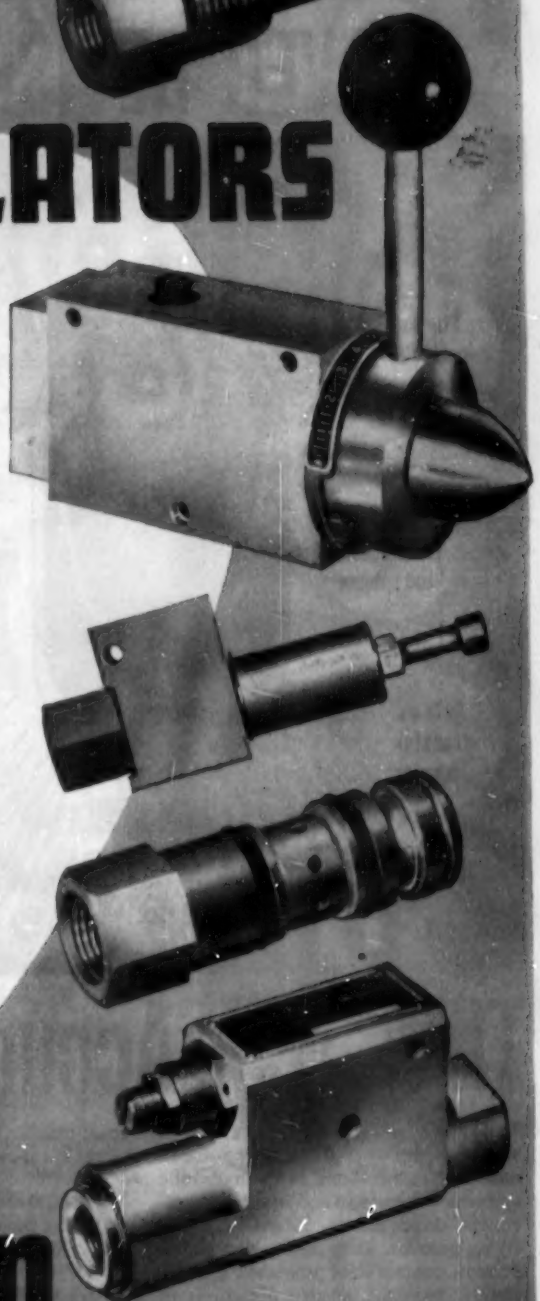
I keep a file of a number of articles from APPLIED HYDRAULICS and ever once in a while I run into trouble when two articles, both of which I want to clip and put in a classified reference file, are back-to-back. Can't the editors watch articles for related subjects? It would help a lot of us keep more complete working files.

FRED ANDERSON
Albany, N. Y.

This is a perennial problem and one which we can't give too much attention to in any one issue. Our major problem is to get a balance of material in each issue and there will be times when run-over pages or back-to-back pages will have material which competes in the interest of almost any of our readers. We will furnish tear sheets, when requested, to help you lick this problem.

WATERMAN

FLOW REGULATORS



WATERMAN ENGINEERING COMPANY is the leading manufacturer of flow regulators and flow controlling devices of the pressure compensated type.

WATERMAN has furnished hundreds of thousands of flow regulators to all types of industries using hydraulics and as a result, has emerged as a specialist in the field of flow control and flow regulation. This has resulted in the accumulation of a wealth of information on flow control applications. **WATERMAN** stands ready to apply this experience and know-how to your flow control problems.

Although a variety of models are being manufactured, there are certain characteristics that are common to all. These characteristics enable the designer to quickly and conveniently determine whether standard **FLOW REGULATORS** will meet his requirements or whether special regulators are required.

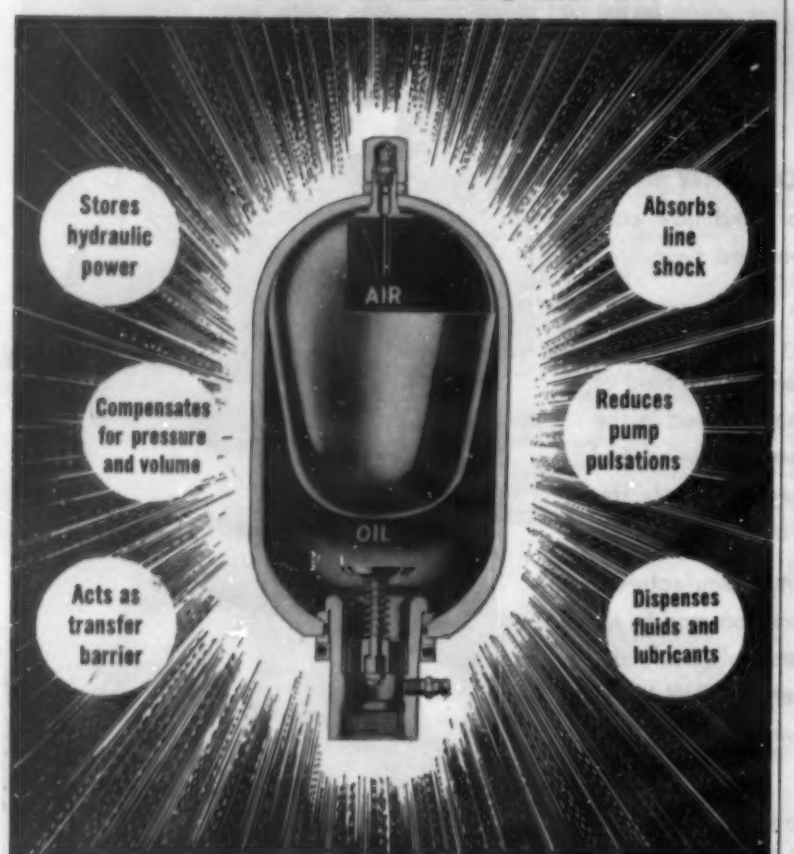
The photos shown on this page illustrate the standard and special types of **WATERMAN FLOW REGULATORS**. The principles embodied in the standard units are readily adaptable to meet a variety of conditions and the same engineering skill and high standards of manufacture will be applied to your special requirements.

Write for latest bulletin A.

WATERMAN
ENGINEERING COMPANY

725 CUSTER AVENUE • EVANSTON, ILLINOIS

MOST VERSATILE HYDRAULIC COMPONENT EVER DEVISED!



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The Greer Accumulator

Today, Greer Accumulators are at work in almost every industry you can name. They are found in the hydraulic systems of buses, construction machines, ships, planes, submarines, and flying missiles. They power all types of presses, control steel processes, operate electric switches, absorb pulsations in oil pipelines—to mention a few of hundreds of applications.

Greer Accumulators can reduce the cost, size, weight, and complexity of your machines and equipment. And Greer's experienced application engineers know where accumulators belong for use, maximum performance and *complete* safety. Let them help you solve your hydraulic problem. Write or call Greer. No obligation. Brochure 301-A gives technical data on the Greer Accumulator. Ask for your free copy today.

GREER HYDRAULICS INC. • International Airport • JAMAICA 30, NEW YORK

Field offices in Chicago, Dayton and Detroit • Sales Representatives in all principal cities

Free Literature Offered in This Month's Ads

For more information circle numbers on the reader service card bound in this issue on page 80.

The complete line, of Anker-Holth AIR and HYDRAULIC CYLINDERS and other products made by the company, is described in a bulletin, now available.

Circle 12 on Reader Service Card

"Engineering with C/R Oil Seals", is the title of a booklet released by Chicago Rawhide Manufacturing Company. SEALS are available in 1800 sizes and 17 standard types.

Circle 23 on Reader Service Card

An aircraft and an industrial catalog, describing FLEXIBLE HOSE in these fields, may be secured from Flex-O-Tube Division of Meridan Corp.

Circle 33 on Reader Service Card

GATE VALVES, available in seven sizes from ¾ in to 4 in line size, are described in catalog 53A, offered by General Controls. Manually operated, and pull-out models available.

Circle 39 on Reader Service Card

Quick-connective FLUID LINE COUPLINGS, available in one-way and two-way shut-off types, are described in a catalog released by The Hansen Manufacturing Company.

Circle 44 on Reader Service Card

New AIR TRAPS, manufactured by W. H. Nicholson & Co., solve sludge problems. Write for catalog 953.

Circle 65 on Reader Service Card

Complete information is given, on an AIR AFTERCOOLER, in bulletin No. 98, offered by Niagara Blower Company. Cools compressed air below the temperature of the surrounding atmosphere.

Circle 64 on Reader Service Card

Continued on page 22

ANCHOR

DUCTILE-SLEEVE, TWO-WIRE BRAID HOSE ASSEMBLIES

for extra safety in high-pressure usage

Factory assembled to your specifications — you get just what you want — plus an extra margin of safety and dependability.

Exclusive, ductile-sleeve, swaged-on grip makes coupling virtually part of hose reinforcing wire — prevents blow-offs.

No leaks — positive seal eliminates leakage even under extreme pressures.

Cuts assembly costs — neat, compact design makes installation fast and easy — gives you a better-looking job.

Get all the details. Attach coupon to your letterhead and mail today.

NEW!
REVOLUTIONARY
ANCHOR FLANCO
SPLIT-FLANGE CLAMP
Positive leakproof connection without threaded joints. Bolt centers are located to distribute the forces evenly and prevent tilting of the clamp halves. Easy to assemble with small automotive-type wrench.

D-16

ANCHOR COUPLING CO. INC.

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I'd like to know more about
☐ Anchor Ductile-Sleeve Hose Assemblies
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Qualifying for use on Air Force and Navy aircraft, this 3,000 lb. MIL-AN-6248 hydraulic hand pump, manufactured by GLADDEN PRODUCTS CORP., 635 W. Colorado, Glendale 4, Calif. underwent a test of 70,000 full cycles—only one change of "O"-Rings was allowed, and volumetric efficiency had to stay at not less than 75%. *The pump, however, equipped with Parco "O"-Rings, finished the rigorous test with a remarkable efficiency rating of 97.8%—with no change of "O"-Rings!* Another example of the extra durability of Parco "O"-Rings—it pays off in better products, greater efficiency and lower costs! All dash numbers of AN 6227, AN 6230, AN 6290, MS 29512 and MS 29513 series for commercial or Army-Navy installations to Specifications MIL-P-5516A, MIL-G-5510A and MIL-P-5315A are available from stock. Silastics and other special compounds supplied on order.

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Free Literature Offered in this Month's Ads

Continued

A complete line of HYDRAULIC TEST MACHINES, ranging from the big test bench to portable machines, are presented in bulletins, released by Sprague Engineering and Sales Corp.

Circle 81 on Reader Service Card

V-RING PACKING, made of Teflon and ideal for manual or automatically operated valves, is described in catalog B-1152, which may be obtained from United States Gasket Co.

Circle 91 on Reader Service Card

Bulletin P-5312 has full details on ELASTOPLASTIC PLUGS and CAPS for protecting threads. In addition to the bulletin, sample plugs and caps are available from The S. S. White Dental Mfg. Co., Plastics Division.

Circle 98 on Reader Service Card

Standard FLOW REGULATORS, to meet a variety of hydraulic system conditions, are described in bulletin A, released by Waterman Engineering Company.

Circle 96 on Reader Service Card

HYDRAULIC CYLINDER AND VALVE bulletin No. 22 is available from Pathon Manufacturing Co.

Circle 68 on Reader Service Card

SELECTOR VALVE, with low turning torque and for pressures up to 6000 psi, is described in catalog No. 454, available from Republic Manufacturing Co.

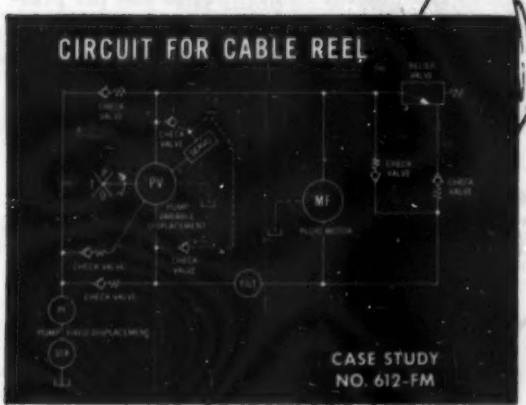
Circle 74 on Reader Service Card

Bulletin 1010, offered by Ledeen Mfg. Co., tells about their fast cycling POWER OPERATED VALVES.

Circle 54 on Reader Service Card

Continued on page 26

Shock loads can't hurt this fluid motor



Denison Axial Piston Fluid Motors recommended for the toughest jobs . . . without qualification

● Quick starts, quick stops, stalling under load, continuous braking. These are the kind of conditions Denison Fluid Motors are built for. Where other motors fail, Denison hydraulic motors operate continuously . . . in conveying equipment, mining, drilling, construction machinery.

Through efficient axial piston design, Denison hydraulic motors pack high horsepower, high torque in a smaller space. The 400 series fluid motor is less than a foot long, weighs only 40 pounds . . . yet delivers 24 horsepower.

Denison Fluid Motors can be furnished to develop up to 180 horsepower, 5665 pounds-inches torque . . . for any hydraulic circuit to 5000 psi.

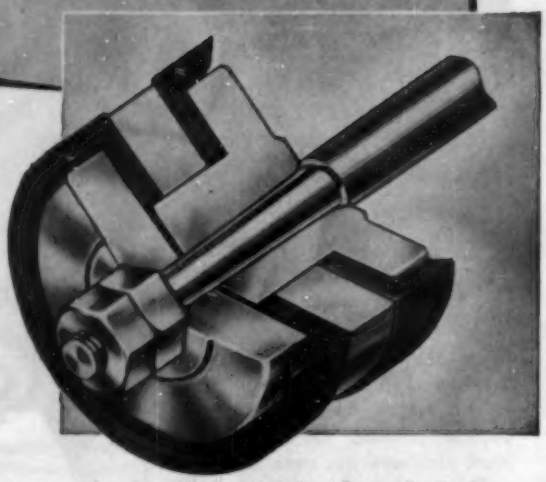
The circuit shows a Denison Fluid Motor that reels cable in and out of oil wells. For bulletins about Denison Fluid Motors, write to: THE DENISON ENGINEERING COMPANY, 1166 Dublin Road, Columbus 16, Ohio.

PUMPS • MOTORS
CONTROLS • PRESSES

DENISON Hydr**OIL**ics

Save POWER...Save SPACE

Pack hydraulic cylinders with these Johns-Manville Custom-Moulded Packings



J-M MOULDED CUPS FOR PISTONS—

The power savings that generally result from the use of J-M Moulded Packing Cups are primarily due to the greater sealing efficiency provided by their pressure sensitive lips. The lips form a tight seal under discharge pressure, practically eliminating slippage past the piston. They relax on the non-working stroke, reducing wear and conserving power.

Precision-moulded for accurate fit, these J-M Packing Cups contribute to lower operating costs because of the improved performance of the equipment on which they are installed.

J-M Moulded Packing Cups are supplied in various types for installation on inside-packed pistons. They are furnished in a wide range of compositions of various compounds and fabrics to suit the pressures, temperatures and services encountered.

UNEEPAC FOR RODS AND PLUNGERS—

This new Johns-Manville automatic ring packing was developed to provide maximum sealing efficiency in minimum packing depth. Often used without header or follower rings, Uneepac is designed so that each sealing ring is a complete packing unit. Its pedestal center section protects the lips from damage by gland pressure . . . and positions them so that they are instantly responsive to fluid pressure changes. This construction results in efficient, automatic sealing, conserves power and reduces wear on rod and packing.

Uneepac is easily installed. Each ring seats itself on the preceding ring in the packing gland. Thus, the entire set is aligned concentrically and vertically—nesting perfectly. Uneepac is available for rod diameters from ⅜" up.

For more complete information about J-M Custom Moulded Packings for Hydraulic Cylinders, write Johns-Manville, Box 60, New York 16, N.Y.

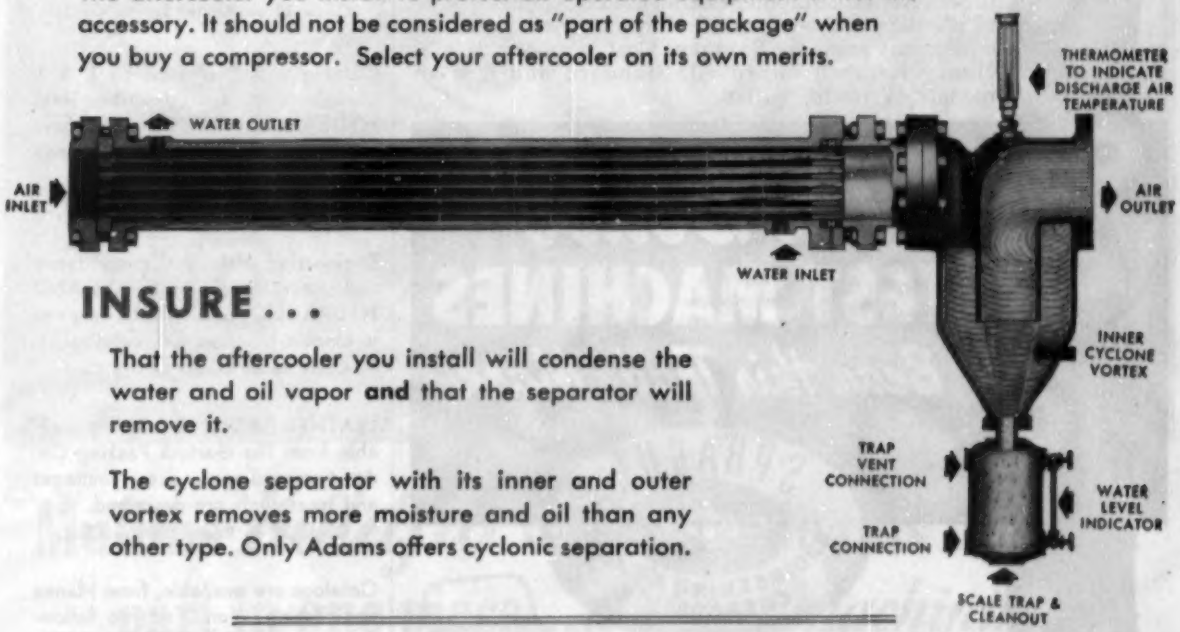
Johns-Manville PACKINGS & GASKETS

LOSING MONEY ON WET, DIRTY AIR?

Rx ...SEE A SPECIALIST!

Removal of moisture from compressed air is a problem entirely independent from the type of compressor used. It is a problem for **specialists** in the design and manufacture of aftercoolers. Specialists for nearly two decades, the R. P. Adams Co. has built a solid reputation on the aftercooler and cyclone separator that are chosen throughout industry for better performance, price and delivery.

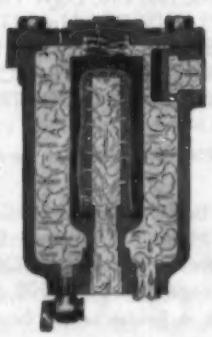
The aftercooler you install to protect air operated equipment is not an accessory. It should not be considered as "part of the package" when you buy a compressor. Select your aftercooler on its own merits.



INSURE...

That the aftercooler you install will condense the water and oil vapor **and** that the separator will remove it.

The cyclone separator with its inner and outer vortex removes more moisture and oil than any other type. Only Adams offers cyclonic separation.



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Why Adams Poro-Stone Air Filters are Famous

1. Rapid diffusion and filtration through permanent, cleanable Poro-Stone.
2. Centrifugal separation of dirt and liquids.
3. Drainage to trap directed by cast-in slots.
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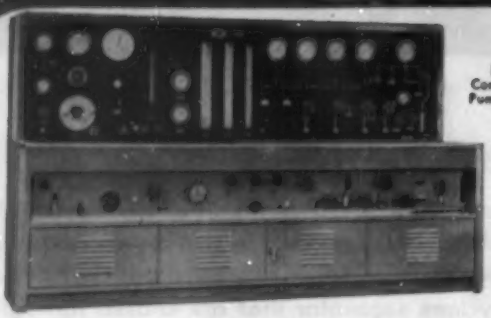


S-169
Hydraulic
Component and
Pump Test Stand

On conducted tours of your factory, is your test department a "must-see" or do you hurry visitors past it because test equipment being used is a hodge-podge of obsolete make-do units? Why not install *modern* equipment made by Sprague! Cost is moderate, efficiency is much improved. Standard and custom models. Write for bulletins.

The Better TEST MACHINES Bear this Trade Mark

SPRAGUE ENGINEERING & SALES CORPORATION

S-271-10
Portable Hydraulic Test Stand

S-404
Portable Hydraulic Power Unit

Sprague builds a complete line of hydraulic test machines ranging from the big test bench, Model S-169, illustrated at top, to various portable machines. Model S-271-10 is a rugged, heavy-duty machine built to take the roughest kind of airport service. Model S-404 is a small, inexpensive unit, designed for spot checks as well as system tests. Several companies buy the S-404 by the dozens for sub-assembly testing. Write for bulletins.

Free Literature Offered in this Month's Ads

Continued

For all the facts on PISTON PACKING, write to Darling Valve & Manufacturing Co. Bulletin No. 4502, describes Pumcups for air and hydraulic mechanisms and No. 4401, Pumcups for reciprocating pumps.

Circle 26 on Reader Service Card

Write for catalog 102, covering HOSE COUPLINGS, and bulletins 231B and 232B on STRAIGHT AND ANGULAR ADAPTER UNIONS. Available from Eastman Manufacturing Company.

Circle 29 on Reader Service Card

Catalog #53, released by L & L Manufacturing Co., describes steel HYDRAULIC COUPLINGS. Several types of couplings and fittings are presented.

Circle 53 on Reader Service Card

Engineering data, on many types and sizes of heavy duty AIR AND HYDRAULIC CYLINDERS, is given in Lincoln Machine Co. catalog.

Circle 55 on Reader Service Card

LEATHER PACKING folder is available from The Garlock Packing Co. All types, shapes, sizes, tannages and treatments are described.

Circle 37 on Reader Service Card

Catalogs are available, from Hanna Engineering Works, on the following products; No. 236, LOW PRESSURE CYLINDERS; No. 233A, HIGH PRESSURE CYLINDERS; No. 750, MEDIUM PRESSURE CYLINDERS; and No. 254, CONTROL VALVES.

Circle 42 on Reader Service Card

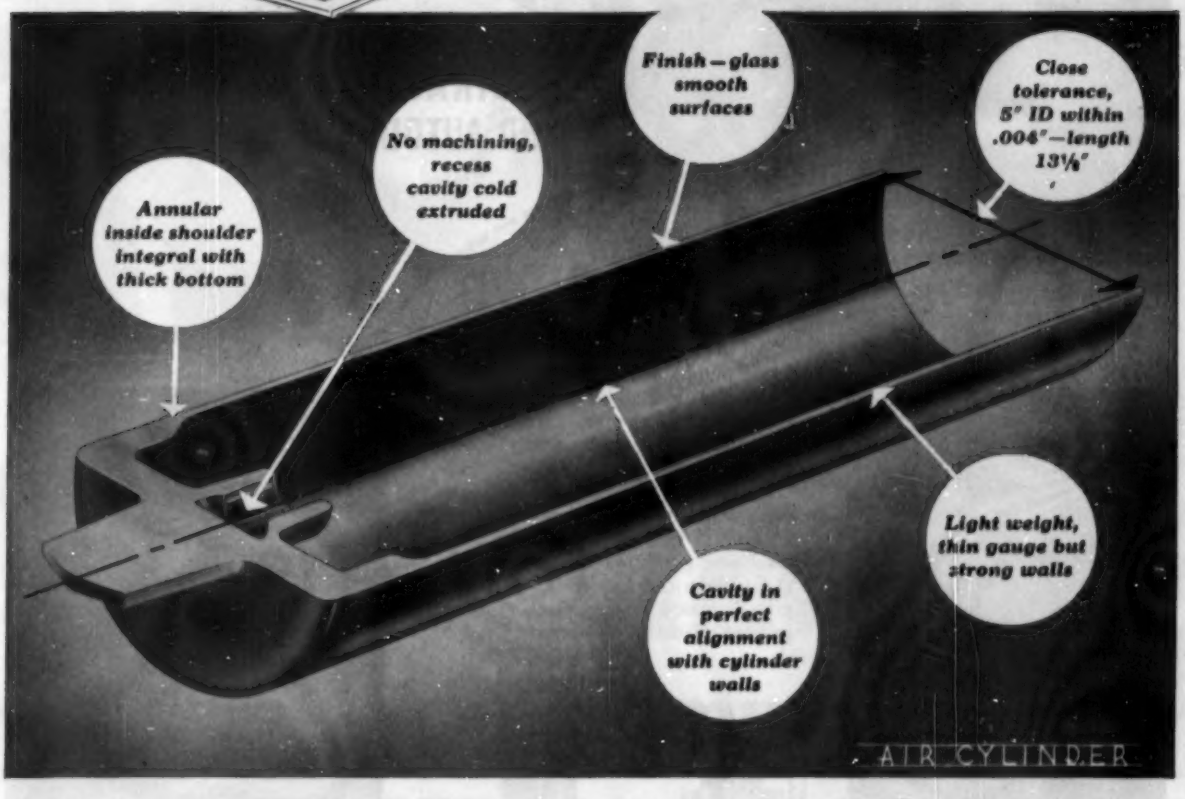
Illustrated bulletins can be obtained from The Heat-X-Changer Co., Inc., on their AIR AFTERCOOLERS, with capacities up to 500 cfm.

Circle 46 on Reader Service Card

For the detailed story, of The Bellows Co., AIR CYLINDER, write for bulletin CL-50. There is a choice available of five built-in valves and five cylinder bore sizes.

Circle 17 on Reader Service Card

Now Mullins Koldflo makes your dream design practical


Finish—glass smooth surfaces
Close tolerance, 5" ID within .004"—length 13⅛"
No machining, recess cavity cold extruded
Annular inside shoulder integral with thick bottom
Light weight, thin gauge but strong walls
Cavity in perfect alignment with cylinder walls
AIR CYLINDER

Mullins *Koldflo* will extrude this finished part in one piece... *without machining*

- **You can now design intricate steel parts the way you want them—without compromise**
- **You can add important new sales features**
- **And Mullins Koldflo design cuts your costs**

WRITE FOR THIS FREE BOOKLET
"How would you tool-up to make an egg?"

MANY of the manufacturing limitations that have plagued creative design engineers are a thing of the past! Now—with the remarkable Mullins *Koldflo* process, you can design intricate steel parts for *one-piece* mass production! A phone call will bring an experienced Mullins *Koldflo* sales engineer to your office—ready to help you design parts that can be mass produced by the Mullins *Koldflo** process! Write for booklet *"How would you tool-up to make an egg?"* *Trade-Mark

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NO LIMIT

TO THE APPLICATION OF ELECTRAULIC HIGH SPEED PUMPS AND AUTODRAULIC CONTROL VALVES

All over the world, Electraulic high speed pumps and Autodraulic control valves (no solenoids) give consistent performance over a wide range of applications. A direct hydraulic system powered by Electraulic pumps and operated by the Autodraulic push-button control system is an independent unit, unaffected by the demands of other machines, giving any desired pressure at fingertip control—it cannot fail to give increased efficiency and economy in *your* plant.

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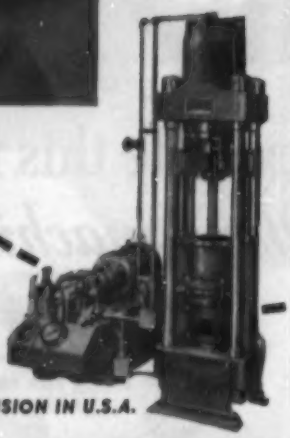
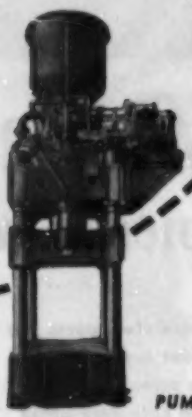
IN-LINE PLUNGER PUMP

Electraulic Twin Straight-in-Line Plunger Pump, mounted in a steel bed-plate tank.



EXTRUSION IN U.S.A.



PUMP BALING IN CANADA.

ELECTRAULIC
HIGH SPEED PUMPS

DIRECT HYDRAULIC SYSTEM

TOWLER BROTHERS (PATENTS) LTD. RODLEY, NR. LEEDS ENGLAND

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2125 HOWARD STREET, CHICAGO 45, ILLINOIS Ambassador 2-1191. TR. 43.

STOP HYDRAULIC OIL FIRES

Use Non-flammable

HOUGHTO-SAFE

get this 4-way safety!

- Snuffer-type—non-flammable
- High Lubricity assures safety against wear
- Non-toxic
- Won't attack packings

Houghto-Safe . . . rated "Acceptable From The Fire Hazard Standpoint" by Factory Mutual Laboratories . . . is safe all around. Ask the Houghton Man for proof of its benefits that far outweigh its low cost. Or get it from E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

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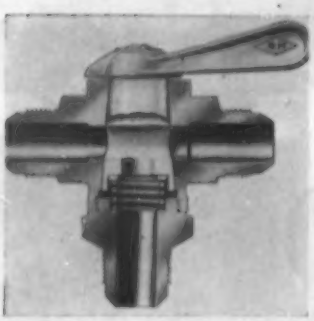
Ready to give you on-the-job service . . .

NEW PRODUCTS

Components, tools and equipment designed to improve operation of fluid power systems are described here . . . for more information fill in and mail the post card bound in this issue.



TAPERED PLUG TYPE VALVE . . . uses Teflon plug

Designation: Lo-Temp
Size: ⅛ to 1 in for pipe and 4 to 12 for tube connections, with a choice of plug drillings.

Construction: Made in angle, 2, 3, and 4-way types, with or without drain, aluminum alloy or stainless steel body, flanged for panel mounting.

Features: Smooth turning in any service or temperature within their range. Leakproof, without lubricant of any kind. The Teflon plug is not affected by acids, alkalis, or gases.

Application: For temperature as low as –65 F and as high as 250 F and pressures to 100 psi.

Republic Manufacturing Company, Cleveland 2, Ohio
Circle 201 on Reader Service Card

MECHANICAL SHAFT SEAL . . . quickly installed

Designation: Type 9
Design: Mounted on a sleeve with an outside clamping ring. Permits quick installation or removal in practically all modern split-case pumps. Is not necessary to unbolt the top of the horizontal split shell.

Specifications: Handles practically all corrosive liquids at temperatures to 500 F. Flexible sealing members are made of chemically inert Teflon.

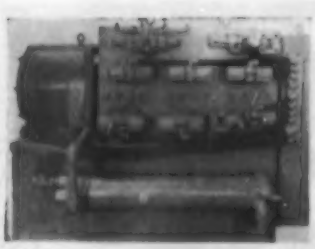
Crane Packing Company, Chicago 13, Illinois
Circle 202 on Reader Service Card

FLUID POWER CYLINDERS . . . large capacity to size ratio

Designation: 750 series; for air or oil to 750 psi.

Design: A more compact cylinder of large capacity with virtually unlimited application, cushion design with positive, easy adjustment, friction reduced to a minimum consistent with positive sealing, components designed of consistent strength, conforms strictly to J.I.C. standards.

Hanna Engineering Works, Chicago 22, Illinois
Circle 203 on Reader Service Card



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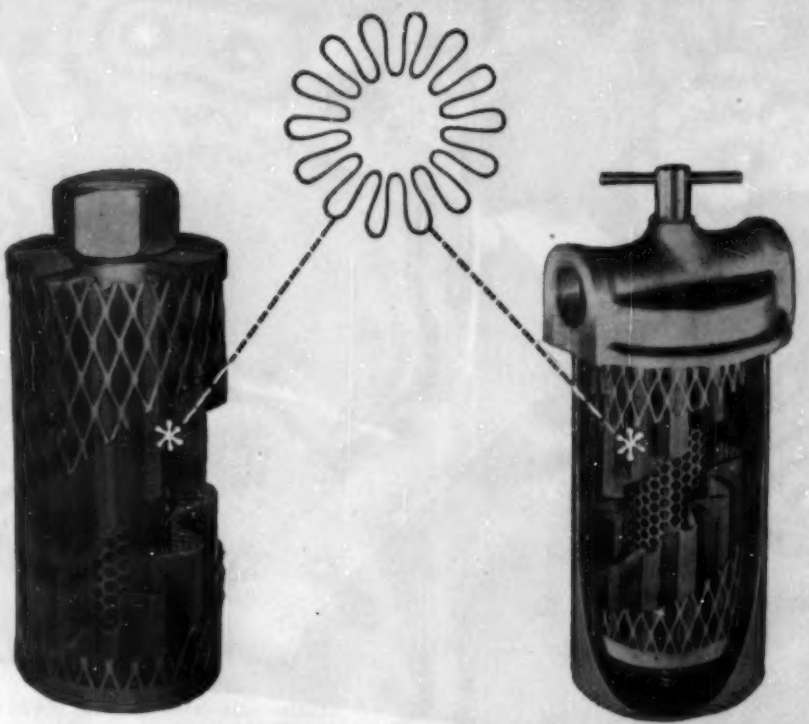
Design: Hydraulic power units in standard, J.I.C. and custom-built designs for operating pressures from 250 to 2000 psi. Included are all necessary motors, pumps, controls, valves, piping oil reservoir; also essential hydraulic accessories such as oil level gauges, filters, cleaners, fittings. The compact simplified design results in substantial savings in installation.

Control Systems Division, Turchan Follower Machine Company, Detroit 4, Mich.
Circle 204 on Reader Service Card

For more NEW PRODUCT reviews turn to page 76

It's the BALANCED Synclinal DESIGN



that makes MARVEL SYNCLINAL FILTERS American Industry's A-1 Choice

In the plants of America's industrial giants, as well as in smaller plants, Marvel Synclinal Filters are installed on all types of hydraulic and other low pressure liquid circulating equipment. Marvels are chosen because of their excellent performance in protecting machines and increasing production by reducing down-time. They are proving again and again, their superiority in the one real test—ON THE JOB! The BALANCED Synclinal Design of Marvel Filters provides that all-important balance between maximum ACTIVE filtering area and sufficient storage space for filtered out particles—therefore, longer periods of productive operation are attained at the absolute minimum of maintenance. They meet J. I. C. Standards.

Not only plant operators, but also, OVER 475 ORIGINAL EQUIPMENT MANUFACTURERS have recognized the superiority of Marvel Synclinal Filters and now install them as standard equipment.

**SPECIFY MARVEL SYNCLINAL FILTERS ON NEW EQUIPMENT—
STANDARDIZE WITH MARVELS ON EXISTING EQUIPMENT**

EASY MAINTENANCE

Both sump and line types may be disassembled, cleaned and reassembled by any workman, on the spot, in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections.

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G. P. M. Choice of monel mesh sizes range from coarse 30 to fine 200.

IMMEDIATE DELIVERY!

Marvel not only delivers a top grade filter in both quality and performance, but delivers IMMEDIATELY. If desired, shipments are made same day orders are received.

WATER FILTERS

We have adapted both our sump and line models for use in all water filtering applications. No changes have been made in the basic balanced synclinal design.

MARVEL *Engineering Company*

Meets J. I. C. Standards

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Marvel Engineering Company AH-8
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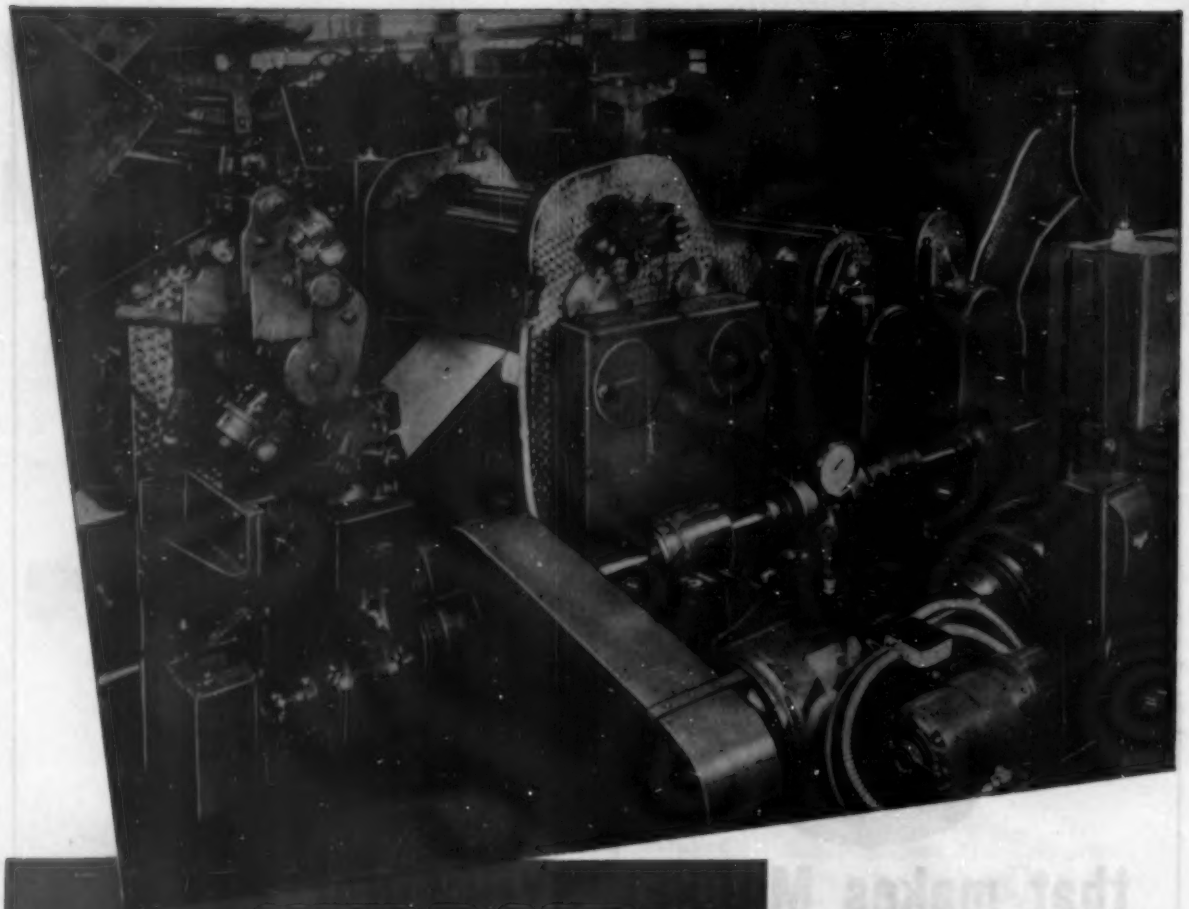
Without obligation, please send me complete engineering data on Marvel Synclinal Filters as follows—

Catalog #106 for Oil Filters
Catalog #300 for Water Filters

Name .....
Company .....
Address .....
City ..... State .....



HYDRAULIC SYSTEMS: how to keep them clean and efficient

KEEPING HYDRAULIC systems clean means keeping them free from sludge, rust and foam. You can do this best by making your medium *Texaco Regal Oil R&O*. Tests prove it has *more than ten times the oxidation-resistance* of ordinary turbine-quality oils—far superior ability to prevent sludge, rust and foam.

With *Texaco Regal Oil R&O*, hydraulic mechanisms of every kind—from the most delicate controls to the largest—operate smoothly and precisely. *Texaco Regal Oil R&O* saves you from unscheduled shutdowns, adds years to pump and parts life, greatly reduces maintenance costs.

Let a Texaco Lubrication Engineer help you get top efficiency from all your hydraulic equipment. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

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FOR ALL HYDRAULIC UNITS

REMOTELY CONTROLLED HYDRAULICS

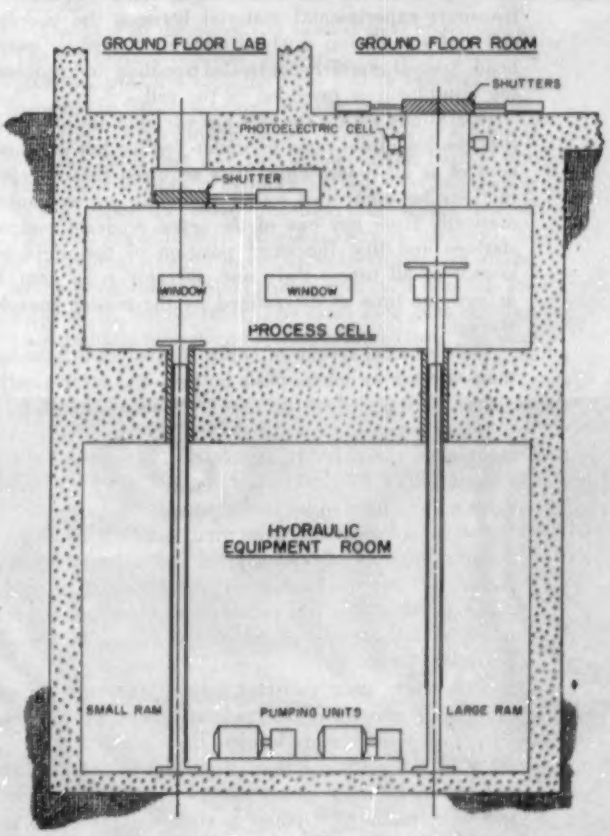
...positions "hot" materials in radiation lab

● By Charles M. George

The relatively new and highly complex science of atomic energy often requires the assistance of old fashioned down-to-earth engineering devices. It is also true that the simplest device may have to be greatly modified to successfully perform its duty when used in an atomic energy installation. Careful consideration must be given not only to what effects radiation might have on a particular item, but also to such things as reliability, service life without maintenance, replaceability under difficult conditions, and even disposability of a contaminated part. This article shows the engineering approach to these matters for one installation at the Los Alamos Scientific Laboratory, which is operated for the Atomic Energy Commission by the University of California.

Several years of intensive study went into the design of the elaborate equipment and facilities of a new laboratory for the atomic energy program. Not the least of its many components was an intricate and massive hydraulic system. The visible result was simply the movement of two large capacity rams, not unlike those used in any service station, and two heavy doors or shutters. Not so apparent, however, were special features involving both manual and semiautomatic control of speed, position, sequence, and safety interlocks. Also not apparent were the requirements for complete reliability of an elaborate system, complicated by the presence of radioactive contaminating surroundings.

The portion of the laboratory with which this article is concerned is illustrated in Figure 1. It consists of two adjacent rooms at ground floor level, a process cell beneath these at basement level, and a hydraulic equipment room at subbasement level. Experimental research carried on within the process cell is of such a nature that the personnel must be protected from radioactivity. Thus, all operations within the cell must be controlled remotely and all equipment must func-



ALL OPERATIONS *within the process cell must be controlled remotely to protect personnel from radioactivity. Operator stations are located behind each window.*

CHARLES M. GEORGE, *Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico*

Hydraulic equipment used for important operations involving atomic energy products must be made as reliable as is humanly possible and then additional equipment must be provided to handle all foreseeable emergencies. All components of this equipment that are exposed to radioactive contamination must be considered expendable.

tion with a maximum of reliability and a minimum of servicing. Viewing windows are provided in the walls of the process cell. One operator station is located behind each of the three windows in an adjacent control room. A master console station located in the center of this control room supervises all activities. This insures coordination of the three operator stations plus two auxiliary control stations on the ground floor and one auxiliary control station in the hydraulic equipment room. Vision for the master console station is provided by an optical system.

The large right hand ram is used to move special equipment and heavy shielded containers into and out of the process cell. The small left hand ram is used to transport experimental material between the process cell and a radiation shielded laboratory directly overhead. Special remotely controlled handling and processing equipment is provided in the cell.

Operations within the cell are variable and demand that the hydraulic rams be under flexible but absolute control at all times. Thus, it is required that all ram motions be controlled either manually or semiautomatically from any one of the seven separate control stations and that the exact position of the units be known at all times. Only one operator is in control at any one time as determined by the master console station.

The electrical system of controls involves little more than selector switches, push buttons and strategically placed limit switches for safe sequential operation.

A very large reservoir located in the hydraulic equipment room holds an abundant reserve of hydraulic oil of 150 SSU viscosity at 100° F. This assures a good head of oil to the pumps, adequate supply for all cylinders at the same time, sufficient cooling of the oil without heat exchangers, and a large dilution factor for any molecular decomposition that might occur. A large filter box employing nine filter elements in parallel is located ahead of the pumps to remove particles and sludge.

Two rotary vane, constant volume hydraulic pumps of 30 gpm capacity at 1000 psig are connected in parallel to the main pressure header. Each pump is powered by a 20 HP electric motor. Both pumps are used for normal operation to assure adequate oil supply regardless of demand. One pump is sufficient for operation of either ram alone, or for total operation at reduced speeds. Excess oil returns to the oil reservoir through an unloading valve or pressure relief valve and is released below the surface to prevent foaming. Hydraulic accumulators are located on the pressure side of the pumps to absorb the shock caused by the sudden closing of any of the main control valves. Oil can enter them freely through a free-flow control valve but is restricted in its back flow into the system.

High pressure in the main header is directed to four separate four-way valves. These control the actions of the two rams and the two shutters and are solenoid operated. Each system beyond these valves is different and functions independently of the others except for the sequence direction of electrical interlocks. The piping and operation of these units is analyzed as follows.

LARGE HYDRAULIC RAM

This ram is designed to lift twenty tons a vertical distance of fifteen feet. In order to prevent the ram from becoming contaminated with radioactive particles in the process cell, two precautions are taken: (1) the piston remains stationary and the cylinder moves so that an oily surface does not enter the cell, and (2) a wash solution floods the outside of the cylinder whenever the ram is raised. The ram and cylinder are made of mild steel tubing that has been hard chrome plated and ground. The cylinder is single acting and "V" type packings are used for all seals.

Normal operation is as follows: Control is switched electrically to one of the operating stations from the master console. The operator energizes the "up" switch to open the solenoid operated four-way valve and start the ram travel. He may select any one of three pre-set travel speeds to meet his operating requirements. However, the ram, by means of limit switches, always starts in slow speed for the first 12 inches and returns to slow speed for the last 12 inches of its travel. When the ram, or any object on the platen, has reached a point just below the shutters, a beam of light focused on a photoelectric cell is interrupted and the ram stops. The platen area of the ram is such that the passageway through the ceiling is essentially sealed off from the process cell. The interruption of the light beams also automatically opens the shutters and trips a limit switch to by-pass the photoelectric cell unit and the ram moves up to the ground floor level at slow speed.

The return sequence is similar in that the ram cannot be lowered beyond the ceiling of the cell until the shutter has been closed. It then proceeds downward by gravity at a pre-selected speed and automatically changes to slow speed when 12 inches from the floor. At its bottom position a limit switch is tripped to shut off the washing solution that has been cleaning the re-

Concluded on page 70

NEW *Fluid Powered* MACHINES

INVERTED PRESS DESIGN

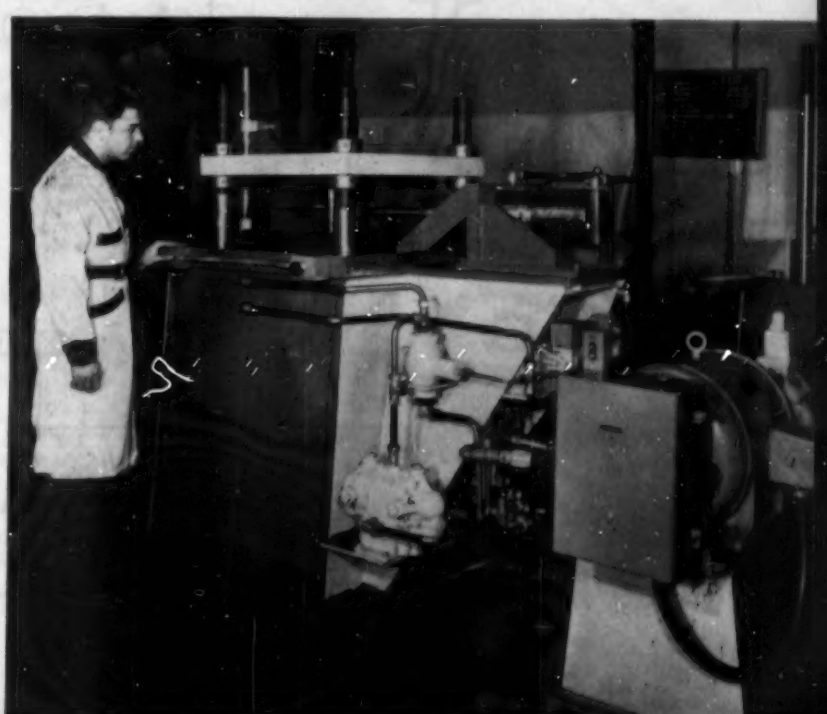
. . . simplifies use of auxiliary cylinders

Press designers are always looking for ways to supply a press which would have no limitations on shut height and which have no limitations on the number of auxiliary cylinders that can be added when needed. While it's too much to expect "no limitations" at all, a new line of inverted vertical hydraulic presses built by Walter P. Hill, Inc., Detroit, Mich., goes a long way toward reducing these limitations.

These presses have the main hydraulic press closing cylinder in the base of the machine, a unique design feature that reduces overall height, minimizes shut height limitations, lowers center of gravity and provides areas at the top and sides for the mounting of auxiliary hydraulic cylinders. Use of auxiliary cylinders permits multiple operations such as piercing or deforming during a deep drawing or extrusion operation.

The base of the presses is welded steel construction. The die closing cylinder, operating on a maximum of 5000 psi pressure supplied by a five to one hydraulic booster, is flange mounted on the bottom side of the die table. This cylinder has its piston rod in a vertical position extending downward toward the base of the press. The hydraulic cylinder imparts vertical motion to the upper die platen through four widely spaced rods that are guided in individual bronze bushings.

Individual straight pieces of metal tubing are placed in the lower die and dual pushbutton cycle controls are actuated by the operator. The press then goes through an automatic operating cycle. The dies close, the aux-



THE HYDRAULIC *closing cylinder in the base of this press has a rated capacity of* 100 *tons. Maximum die travel, limited by cylinder stroke, is* 6 *inches. The auxiliary cylinder has a rating of* 75 *tons.*

iliary cylinder, or cylinders, at various locations on the machine extrude, the tube to the desired form, and the dies open. The finished elbow, tee or U bend is removed and the machine is ready to produce another part.

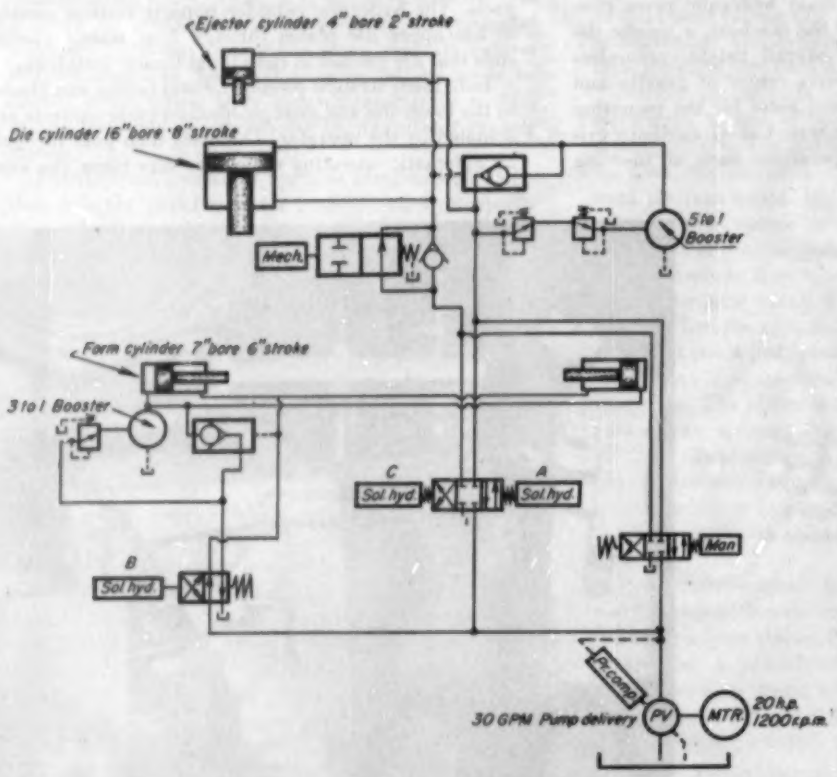
Release of pressure on either or both pushbutton controls during the cycle before die closure causes the upper die to immediately retract to upper position where it remains until the buttons are both simultaneously depressed. This feature provides maximum operator safety.

While the hydraulic circuit shown in the accompanying drawing is used on a press which is specifically designed to extrude tee's, the basic power package is similar on the entire line of inverted presses. A pressure compensated 30 gpm, variable volume vane pump supplies the circuit with oil pressure up to 1000 psi. Oil pressure up to 3000 psi at the die cylinder is provided by a reciprocating type booster which is located close to the cylinder to keep the length of high pressure lines to a minimum.

This circuit uses a 16 inch diameter die closing cylinder to give a 300 ton rating when the oil pressure on the cylinder is 3000 psi. A separate 3 to 1 booster supplies high pressure oil to the two auxiliary cylinders.

CLOSEUP *of the die used to make U bends in tubing*

After the workpiece is loaded in the die, press operation is started by a pushbutton energizing solenoid "A". Low pressure oil raises the ejector cylinder and closes the dies. With dies closed, pressure overcomes the setting of the sequence valve and oil flows through the pressure reducing valve to the booster. The booster then supplies high pressure oil to the die cylinder. Solenoid "B" is energized to direct oil from the pump to the two forming cylinders.



HIGH PRESSURE *oil is supplied by reciprocating boosters. High pressure lines are kept short and fittings resisting pressures up to 20,000 psi are used as a safety factor in these lines. On other presses of this new line, this circuit is modified by the changing of cylinders.*

HYDRAULIC HOSE

• construction
• selection
• application

By J. A. Muller

Modern hydraulic hose will withstand high pressures (up to 4500 psi) and resist dimensional changes from extremely high and low temperatures. Whenever there is considerable movement of one piece of equipment relative to an attached piece, hydraulic fluid carried through flexible rubber hose may be the best answer to the problem. Even when there is no motion of one part of a machine relative to another, the transfer of impulses by fluid through a hose may be preferred over metal piping because of the low resistance to flow of hose in the elimination many sharp turns and right angles.

There are four principal types of hydraulic hose available today: high pressure (4500 psi max.) wire braid hose, a wire braid hose with a cover of specially treated cotton yarn (3000 psi max.), medium pressure (1200 psi max.) rayon braid hose, and low pressure (500 psi max.) rayon braid hose. Operating temperatures for hose of this type range from -40F to 200F (see Table Nos. 1-4). In addition, a special hose is manufactured for suction lines to the hydraulic pump.

Hydraulic hose consists of an inner tube, a carcass of rayon or steel braiding and a cover. In addition, hose especially designed for reusable couplings is made having in lieu of a rubber cover, one composed of tightly braided and treated cotton yarn. The tube is specially compounded to resist attack from oil and the materials most often used in hydraulic fluids. The type and thickness (number of plies) of the carcass determine the working pressures of the hose. The cover is designed to withstand the various working conditions encountered such as resistance to attack by oil and grease, sunlight, abrasion and impacts.

In hydraulic hose, the carcass is of utmost importance. In the high pressure hose, the carcass is composed of one or more braids of steel wire with a ply of cotton braid between the wire and the cover. The medium pressure hose has two braids or plies of high tensile rayon yarn. The low pressure hose has one braid of high tensile rayon yarn.

In the case of the suction line hose, bursting strength is not as important as resistance of the hose to collapse under suction. Therefore, this hose has a wire spiral inter-woven in the cotton carcass to prevent reduced I.D. under suction. This hose holds its round shape under all conditions.

Although couplings are not a component of hose, they are an important part of any hose system. In high-pressure hydraulic applications the couplings

WIDE APPLICATION *of hose is made on agricultural equipment where flexible lines are necessary. A hand operated valve gives the tractor driver complete control of the implement.*

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become the most critical factor. The coupling should be chosen as carefully as the hose. There are several types from which a selection can be made. For instance, there is the pressed-on coupling that is permanently attached to the hose. There are also re-usable couplings, such as clamp-on types and others of the screw-in expanding nipple type (aircraft), which can be disconnected from the hose and used many times. Generally, hydraulic hose is furnished as an integral part of major equipment with the couplings already installed. In the event of damage to a length of hydraulic hose or its couplings, it is important to replace it with the same hose type and couplings. This can usually be obtained direct from the original manufacturer.

Here are some tips on selection and use of hydraulic hose:

1. Will the hose chosen withstand attack from the *material carried*? Hydraulic hose is designed to carry all commonly used hydraulic fluids. Use only recommended hydraulic fluids.
2. *Working Pressure* Stay within manufacturer's limits. Some hose will handle extra pressure for a while but it will fail more quickly and more than likely, unexpectedly, with damage to personnel and equipment and loss of production.
3. The *temperature* of both the material being carried and ambient temperatures should be considered. Provision should be made in a heavy-duty hydraulic system for heat dissipation to prevent the temperature of the fluid from rising too high.
4. The inside diameter of a hose determines the *carrying capacity*. If the diameter is too small, you won't get the volume required. Too large a diameter means lower pressure.
5. Specify *enough length* to avoid stretching. Excessive length increases the chance of kinking. Provide enough hose length in connecting parts with considerable relative motion to allow for maximum movement without causing hose to pull on couplings. In connecting parts that must be disassembled from the main machine frequently for adjustment, maintenance or repair, provide enough hose length so that the part can be handled easily without restriction from the hose and without being disconnected from the hose.
6. The hose system is only as good as its *couplings*. Even the best hose can't operate with incorrect, improperly applied couplings. In hydraulic systems, be sure that there is no tension on the couplings.

Table 1
High Pressure Wire Braided Hydraulic Hose

I. D.	Braid	Maximum Working Pressure #/Sq.In.	Length Change at Maximum Working Pressure %	Minimum Bend Radius
3/16"	1	3000	+0 −6	4"
¼"	1	2500	+0 −6	4"
5/16"	1	2000	+2 −4	5"
⅜"	1	2000	+2 −4	5"
7/16"	1	2000	+2 −4	6"
½"	1	1750	+2 −4	7"
⅝"	1	1500	+2 −4	8"
¾"	1	1250	+2 −4	9½"
1"	1	1000	+2 −4	9½"
1¼"	1	625	+2 −4	16"
1½"	1	500	+2 −4	20"
2"	1	400	+2 −4	22"
3/16"	2	4500	+0 −6	4"
¼"	2	4500	+0 −6	4"
5/16"	2	4000	+2 −4	5"
⅜"	2	3500	+2 −4	5"
½"	2	3000	+2 −4	7"
⅝"	2	2500	+2 −4	8"
¾"	2	2250	+2 −4	9½"
1"	2	1875	+2 −4	9½"
1¼"	2	1200	+2 −4	16"
1¼"	2 H	1625	+2 −4	16"
1½"	2	900	+2 −4	20"
1½"	2 H	1250	+2 −4	20"
2"	2	750	+2 −4	22"
2"	2 H	1000	+2 −4	22"

Single Braid Hose Meets SAE 100-R1
Double Braid Hose Meets SAE 100-R2

HYDRAULICS AND HOSE *are widely used on earth-moving machinery such as this bulldozer. The hose supplying hydraulic pressure to the cylinders permits considerable movement of the blade relative to the basic unit.*

APPLICATIONS OF HOSE

Among the countless industrial applications of hydraulic controls is the fork-lift truck. Here we have several different movements which must be controlled

BOOMS UP TO 100 *ft long are moved in three directions through hydraulic controls manipulated by the operator from his position at the end of the boom. Hydraulic hose carries flaid from pump to cylinders.*

by the operator from the central point, usually his seat on the truck. For instance, the forks must be elevated and lowered. The mast is tilted from a vertical position back a few degrees for transporting. Many special attachments permit the load on the forks to be rotated. Sometimes clamps are used instead of forks. Sideways motion of the forks is often required. Some models are equipped with a clamping device to steady the load on the forks especially in cases where the mast is tilted forward. All of these various movements can be actuated by hydraulic power supplied through hose from a central pump. Through the use of release valves, the movement is controlled within safe limits and there is no danger of overrun or breakage. In addition, a hydraulic control system of this type does not require as much room as would separate electric motors for each movement with limit switches.

CONNECTING FARM IMPLEMENTS

Farm equipment offers many interesting examples of hydraulic controls. In many cases, the working unit consists of a tractor which tows a plow, harrow or seeder. The movement of the towed unit is great relative to the movement of the tractor. Rubber hose offers the best solution to the problem of permitting the tractor operator to control the adjustment of the towed equipment.

Earth moving machinery such as graders and power excavating equipment also use hydraulic power to advantage. Not only are many different movements controlled from the operator's station but the force required of the operator to initiate the movement by hydraulic power is far less than that required under manual controls.

REDUCTION OF SPACE

The space-saving feature of the use of hydraulic power is strikingly illustrated by a truck equipped for mixing concrete in transit. Instead of a separate gasoline engine to rotate the mixer and elevate it for discharge, a small hydraulic pump powered by a take-off from the truck motor itself, supplies the power for turning the mixer and elevating it for dumping.

In the modern aircraft, hydraulic controls show their most brilliant colors. In the military and commercial planes the most stringent requirements of precise movement, reliability and space saving are met. The movements of wing and tail assemblies which could be actuated manually by the pilot at the relatively slow speeds of only a few years ago now require mechanical aid from a complex hydraulic network.

It is expected that impulses transmitted hydraulically through rubber hose will play a large part in the fast-developing field of automation. Here again, we have the need for precise control of movement, efficient space utilization and flexibility.

Table 2
Medium Pressure Hydraulic Hose (2 Ply Rayon)

I. D.	Braid	Maximum Working Pressure #/Sq. In.	Minimum Bending Radius
1/4"	2	1250	3"
5/16"	2	1200	3"
3/8"	2	1125	4"
1/2"	2	1000	5"
3/4"	2	750	6"
1"	2	550	8"
1 1/4"	2	375	10"

MEETS SAE—100 R3

Table 3
Low Pressure Hydraulic Hose (1 Ply Rayon)

I. D.	Braid	Maximum Working Pressure #/Sq. In.	Minimum Bending Radius
3/16"	1	500	3"
1/4"	1	400	3"
5/16"	1	400	3"
3/8"	1	400	4"
1/2"	1	400	5"
5/8"	1	350	5"
3/4"	1	300	6"

Table 4
Wire Braid Cotton Covered Hydraulic Hose

I. D.	Maximum Working Pressure #/Sq. In.	Minimum Bending Radius
3/16"	3000	3"
1/4"	2500	3 3/8"
5/16"	2250	4"
13/32"	2000	4 5/8"
1/2"	1750	5 1/2"
5/8"	1500	6 1/2"
7/8"	800	7 3/8"

MEETS SAE—100 R5

ON automatic equipment which is getting hard use, most hydraulic components have long service records. Unfortunately many pumps, valves and cylinders are damaged by poor system maintenance long before they get a chance to wear out.

FIG. 1. ABOUT 10 percent of the hydraulic components in your plant will wind up on a repair bench. You can save them for more hours of useful life if the repairman has the proper know-how. This valve was ruined beyond further use because heat from brazing caused the precision bore to warp.

MAINTENANCE HINTS

will Increase Component Life

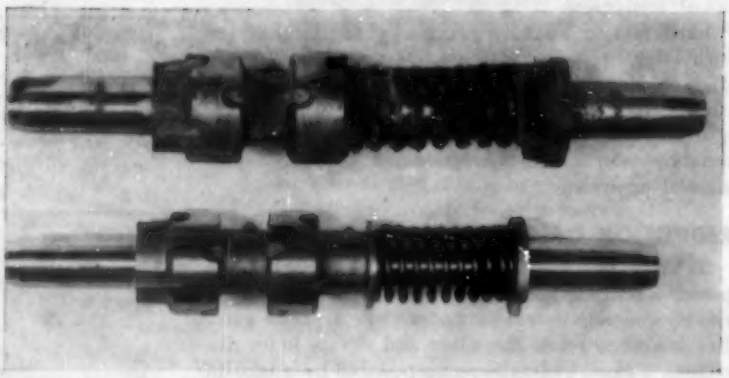


FIG. 2. THE BIGGEST reason for component failure is improper care of the hydraulic oil. Dirt and sludge have ruined this valve spool and made the spring inoperative. Proper filters to remove dirt; temperature control to avoid heat, and periodic oil change would prevent this sort of damage. More than 70 percent of all system troubles are caused by poor condition of the hydraulic fluid.

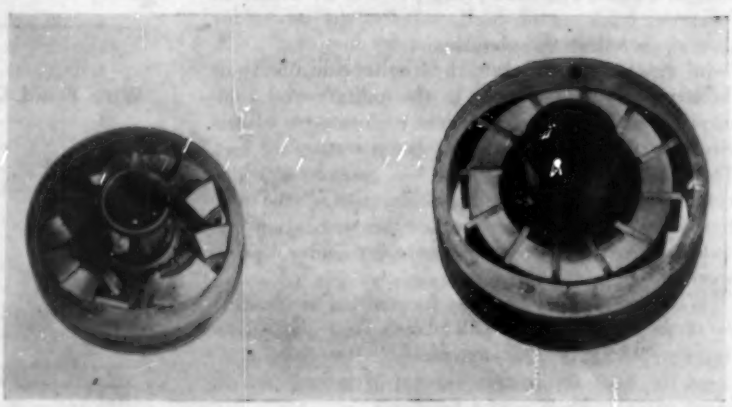


FIG. 3. This failure of a vane pump can not be blamed entirely on poor maintenance. It is an example of severely overloading a system. Pressure surges beyond recommended limits smashed the pump rotor. Locking of the relief valve at a safe maximum pressure might have prevented this failure.

PART 1

GEAR PUMPS

HYDRAULIC NOISE

in Positive Displacement Pumps

● By E. L. Midgette

HYDRAULIC noise in positive displacement pumps and motors is essentially a function of the time rate of change of pressure. There seems to be a value of this function below which the noise is not generally audible, but for values above this minimum or threshold level the audible noise steadily increases. Since the very nature of the high pressure hydraulic pumping unit necessitates the existence of rapid changes of pressure, it is then up to the designer to insure that a pump designed for a given service shall be so made as to hold this rate of change of pressure to a minimum, even though it is impossible to eliminate it altogether.

In the common types of hydraulic pumps there are three major ways of introducing or creating greater than necessary values of rates of pressure change. These three major ways may be listed as (1) incomplete filling; (2) sudden introduction of the fluid under suction pressure to the region of full discharge pressure; (3) trapping fluid at full discharge pressure against the seal area between the discharge and suction sides of the pump.

Limiting the major sources of hydraulic noise to the above three, inherently assumes that the fluid being handled is solid, free from air bubbles and free of emulsification. This assumption must be made by the designer, since the conditions of the fluid in these respects are not generally under his control, but are determined largely by the particular installation under which the pump must perform its function. With this assumption in mind, it is still true that the relative significance of the above three sources of trouble varies with the type of pump and the speed of its operation.

In designing a gear, vane or piston pump, the designer must make the assumption that there will be an adequate quantity of solid fluid available at near atmospheric pressure, or above, to the suction opening of the pump.

Remembering the significance of the above three sources of noise, the designer of a gear pump should pay every attention to incomplete filling and trapping of oil. Sudden introduction of the fluid under suction pressure to the region of full discharge pressure is not of such paramount importance since the fluid passing through a gear pump under stated operating conditions normally has the time of about one-half the revolution of the driving shaft during which its pressure is increased from the suction side pressure to the discharge side pressure of the unit.

AFFECT OF OPERATING SPEED

Since, it is the time rate of change of pressure which throws energy into noise creation, it must follow that for all types of pumps noise from each of the three sources is a function of the operating speed of the unit. Then it would follow that a very noisy pump at, say, 1800 rpm operation would generate considerably less noise operated at half that speed. Even though speed in this manner affects the level of noise in all types of pumps, it will not be used here as a means of controlling that noise because there are so many other things

E. L. MIDGETTE, Head of Mechanical Engineering Dept. Polytechnic Institute of Brooklyn

such as size, weight, cost, etc., that dictate the minimum speed of operation of a pump for a given purpose.

Once the designer has decided the type of pump he is going to design for a given function, its basic size, arrangement, and its operating speed, he should consider the noise problem. Suppose the pump design is a simple pair of external gears rotating in a pressure-tight housing, arranged in a common manner. Then according to the above analysis, the designer should study his detail layout with the idea of minimizing any filling problem on the suction side and any possibility of trapping fluids at the seal point between the discharge and the suction side. Making the assumption that plenty of solid fluid is available at the suction side of the pump, satisfactory filling can usually be achieved by merely assuring a low flow speed of that fluid into the suction section by allowing ample flow areas. However, it is possible to keep this flow at a fairly good rate and still have adequate filling if it is remembered that the fluid coming through into the suction chamber usually has its full velocity directed toward the mesh point between the gears and that, in order for it to join the fluid and be transferred around the periphery of the gears, this velocity must be changed through an angle of 90 degrees.

By proper fairing, see Figure 1, it is possible to allow this directional change to occur around a radius of large length rather than around a sharp corner and in this manner create less turbulence, smoother flow and adequate filling. If these precautions are taken, excellent filling can be achieved with the normal viscosity fluids with average flow velocity as high as 8 to 10 feet per second.

RELIEF FOR TRAPPED FLUID

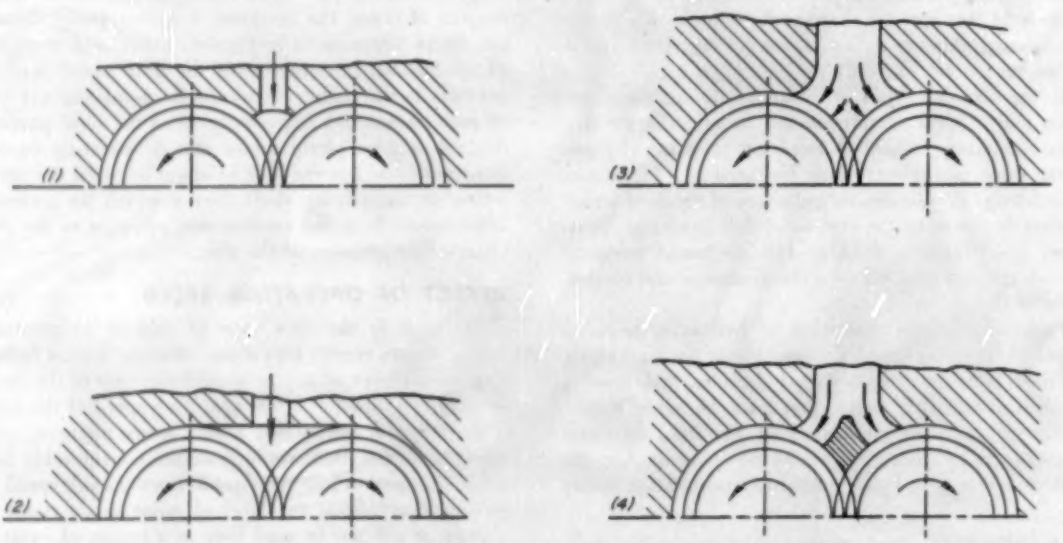
Next the designer should look at the point where contact starts between driving and driven gear teeth on the discharge side. A large scale drawing of this tooth mesh clearly shows that there is a considerable quantity of fluid trapped between the side and tip of the driven tooth and the bottom of the space and the trailing face of the leading tooth on the driving gear. This quantity of fluid, which under certain designs may become as much as 10 or 15 percent of the fluid that would lie in the space between adjacent teeth, is trapped at full discharge pressure. Depending upon the length of contact path, in a very few degrees of gear rotation, this trapped fluid will have to assume a space considerably smaller since the driven tooth presses in and compresses it against the driving surfaces.

If no provision is made to allow this fluid to pass

FIG. 1. Improving Filling Conditions

These four sketches show design of the gear pump suction port. Bad filling would result in the pump design shown in sketch 1. At high rotating speeds, high velocity oil is directed at the mesh point. Direction of velocity must be changed 90 degrees.

Machining the gear pump housing as shown in sketch 2 improves the filling condition. Creating a radius as shown in sketch 3 offers further improvement. Where pump noise due to filling conditions is an extreme problem, the design shown in sketch 4 would be desirable. These improvements reduce turbulence and give adequate filling at flow velocities as high as 8 to 10 fps.



Noise in hydraulic pumps can be minimized if the time rate of change of pressure is controlled. Three sources of pressure change are incomplete filling at the suction port; sudden introduction of low pressure oil to a high pressure discharge; and trapping of high pressure fluid between the discharge and suction sides of the pump.

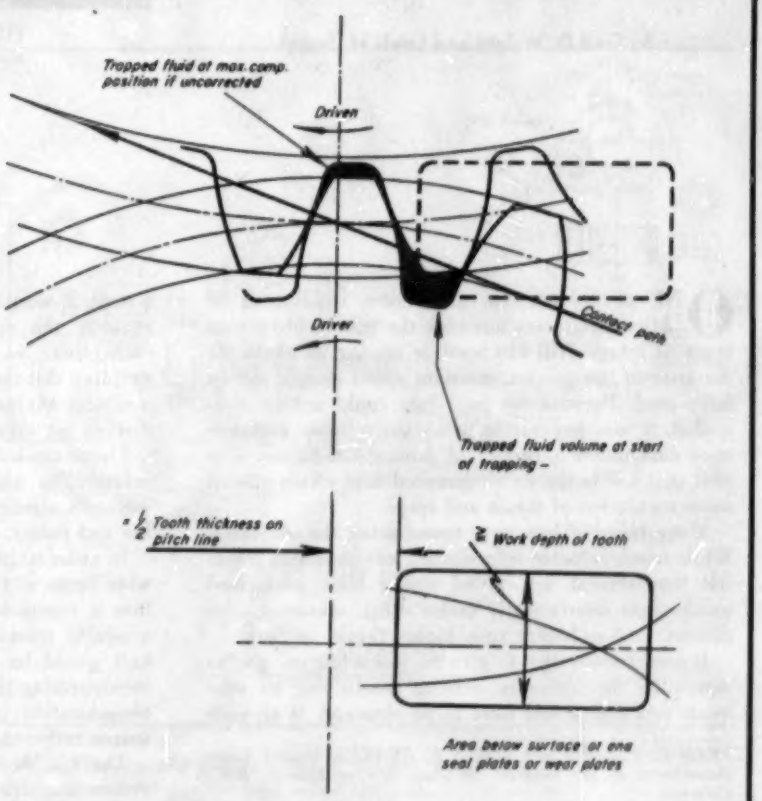
out freely to discharge side, its pressure will be considerably increased as it is compressed, since there is no other way for the fluid to get out except by side leakage. If side leakage is low the pressure created at this point may run to as high as three or four times discharge pressure, and it is built up extremely rapidly in a very few degrees of gear rotation. It is the designer's problem to arrange methods of allowing this trapped fluid to escape. One method is by having the gear side clearances large enough so that with a slight build up of pressure this fluid will partially leak into the discharge side across the ends of the teeth, as well as leak across the ends of the teeth into the suction side. Backlash in the gears in any significant quantity will also allow this fluid to pass through from the trap area over the faces of the teeth to the suction side.

Both of these methods are expensive from the standpoint of volumetric efficiency, if for no other reason, and since manufacturing tolerances dictate in large part the thickness of the film through which flow can take place in this respect, it is very difficult for the designer to determine just what relief he will get from either of these two methods. On the other hand, it is but a simple operation for him to make a passage in the cover plates, Figure 2, over the end of the gears which would connect this trapped fluid openly to the discharge side of the unit and, in this way, assure that at least the pressure build up on this trapped fluid would be only slightly above that of the average discharge pressure.

Part 2 of this series will discuss hydraulic noise in vane and piston pumps.

FIG. 2. Correcting Trapping of Fluid

As the gear teeth mesh, the trapped volume is compressed into a smaller space. This compression may be relieved to the discharge side by machining a relief in the seal or wear plates as shown in the sketch.


Trapped fluid at max. comp. position if uncorrected
Driven
Driver
Contact Area
Trapped fluid volume at start of trapping –
= ½ Tooth thickness on pitch line
½ Work depth of tooth
Area below surface of one seal plates or wear plates

This machine was designed using hydraulics because there was a need for . . .

CONTROLLED SPEED...

Thrust and Torque

By Fred D. Wright and Lewis H. Brakel

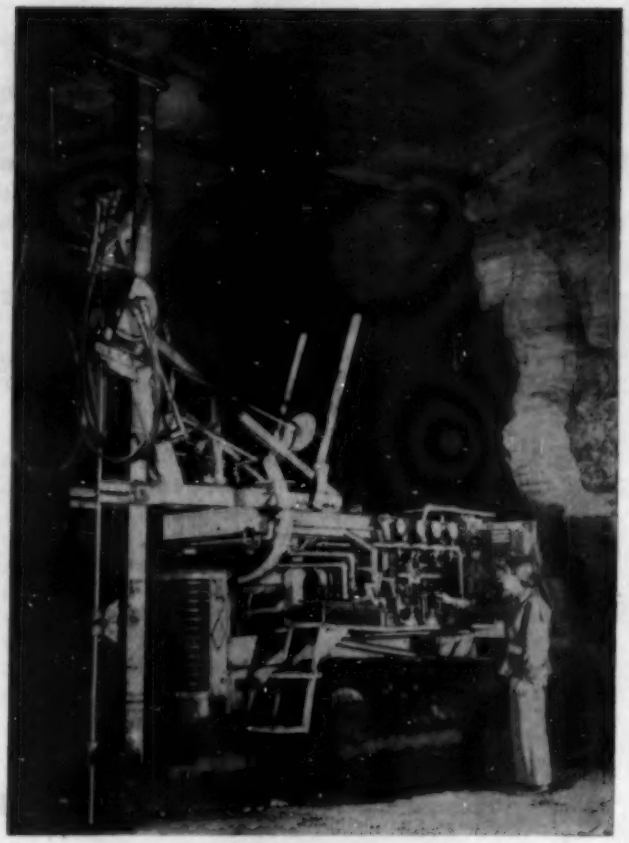


FIG. 1. DRILLING *a vertical hole with the hydraulically powered test drill.*

ONE of the projects undertaken by Bureau of Mines engineers has been the testing of various types of rotary drill bits used in mining oil shale. At the start of the project, constant speed electric drives were used. Because the feed rate could not be controlled, it was impossible to obtain reliable performance data under a variety of mining conditions. The next step was to use an air powered drill which offered some regulation of thrust and speed.

Many types of bits were tested using the air drive. While much valuable information was obtained, it was felt that several bits tested might have performed much more satisfactorily under other operating conditions, such as higher rpm, higher thrust, or both.

It was obvious that, to give the bits a fair test and to determine the optimum drilling conditions, an adequate test drill would have to be obtained. With such a drill, it would be possible to vary and measure accurately the operating conditions independently of each other. No such drill was on the market. Before deciding that the Bureau should build such a machine, a careful analysis of the possible advantages of rotary drilling for oil-shale mining was made.

The analysis indicated that a test drill could provide information which would greatly reduce actual drilling costs, eliminate a great part of the noise from drilling and reduce capital costs for mining equipment.

In order to have a test drill that could operate under wide limits of thrust, rpm, and torque, it was decided that a completely hydraulic drill was required. An available tractor was selected upon which the drill unit would be mounted, and the unit was designed incorporating the various desired features. A primary consideration influencing the design was that a research rather than a production tool was to be built.

The specification for the hydraulic equipment and system was drawn up. TEC Engineering Corporation,

FRED D. WRIGHT and LEWIS H. BRAKEL, United States Department of the Interior, Oil-Shale Mining Branch, Rifle, Colorado

Logansport, Indiana, undertook the final building and layout of the hydraulic system.

The completed test drill (Figure 1) consists of a hydraulic drill motor mounted on a 15-foot feed carriage. The drill motor can develop a maximum torque of 2,100 inch-pounds and can be controlled between 0 and 1,050 rpm. It has a hollow drive shaft and water swivel for wet drilling. The drill motor is mounted on a slide or carriage, which is attached to an endless chain. This chain is driven by a hydraulic feed motor and can deliver a maximum thrust of 4,000 pounds to the drill motor. Both thrust and torque can be preset to any desired value below their maximum limits. A 50-hp., 440-volt electric motor operates the hydraulic pumps that drive the motors.

The complete hydraulic system of the rotary test drill is shown in Figure 2, and a diagram of the track-mounted unit is shown in Figure 3.

There are actually two separate hydraulic systems, one for the drill motor and one for the feed motor and jacks. This makes it easy to cut out the hydraulic drill-motor circuit if an electric motor is tested for a drill motor. The pumps for both systems are driven by a single 50-hp, 1,200-rpm electric motor. The drill motor pump supplies approximately 46 gpm of hydraulic fluid at a maximum pressure of 1,600 psi. The oil flows from the pump directly to a lever-operated, 1½-inch-size, four-way valve, which has three position detents with all ports open in neutral. Therefore, oil will flow freely back to the tank through this valve when the handle is in the neutral position. The outlet ports of the valve are connected with the drill motor permitting the motor to be run in either direction. A pilot-operated, 1½-inch, pressure-relief valve is connected through a tee with the line from the pump to the four-way valve to limit the maximum pressure in the circuit. A pressure gage, calibrated in inch-pounds of torque, is attached to the relief valve to show the pressure in the circuit and the resulting drill-motor torque. If a maximum torque of less than 2,100 inch-pounds is desired, the pressure-relief valve can be easily adjusted to the value desired. A 1½-inch dial-type flow-control valve also is connected through a tee with the supply line. This valve can be adjusted for bypassing back to the tank any flow varying from 0 to 50 gallons per minute, thereby controlling the speed of the drill motor. This valve passes a uniform flow for any particular setting unaffected by the pressure in the system. Any surplus oil not required, owing to reduced speed, is bypassed back to the tank.

FEED MOTOR AND JACK CIRCUIT

There are two other hydraulic pumps in the circuit, which serve the feed motor and the two jacks. Two pumps were used to eliminate the need for expensive variable-delivery pumps. These pumps, a 24-gpm low-pressure pump and a 5 gpm high-pressure pump, furnish power to the feed motor, which, through a gear reducer and an endless chain, can exert a thrust up to 4,000 pounds on the drill motor when it is being advanced and a thrust of 1,000 pounds when it is being retracted. Maximum linear speed of the drill

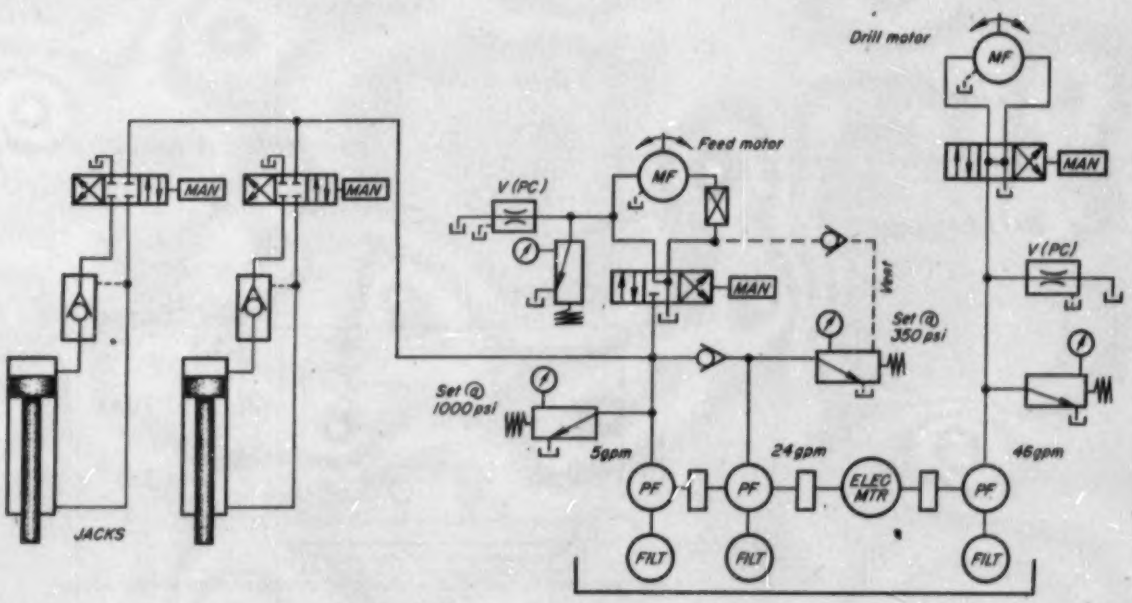


FIG. 2. ROTARY FLUID MOTORS *power the feed and drill on the test rig. Adjustment of relief valve settings and bypass flow control valves regulate the speed, thrust and torque.*

motor along the slide is 18 feet per minute when advancing and 100 feet per minute when retracting.

The 5-gpm pump provides pressure up to 950 psi to the feed motor, when feeding forward. Both pumps running together provide approximately 28 gpm at 350 psi for the feed motor during retraction of the drill.

The 24-gpm pump also can feed into the four-way valve through a check valve. This valve prevents oil from the high-pressure pump from backing into the low-pressure pump when the smaller pump is operating at pressures above 350 psi. The low-pressure pump is protected by a pressure relief valve set at 350 psi. This relief valve has a remote control or vent connection, which is connected through a ¼-inch check valve with the line from the four-way valve to the feed motor, which is under pressure during retraction of the drill. The needle valve in this same line permits adjustment of the return speed.

The four-way valve for the feed motor is equipped with three position detents. When the valve is in neutral position, the oil inlet port is blocked while the right outlet port is connected with the exhaust. This is done to permit the remote controlled pressure-relief valve for the 24-gpm low-pressure pump to be unloaded to approximately 150 psi by means of the control vent line with ¼-inch check valve, whenever the four-way valve is in neutral and the feed motor is not running. When the drill is being fed forward, the right outlet port is connected to the exhaust. Thus, when the drill is being fed forward, the low-pressure pump is being unloaded through the pressure-relief valve, and the high-pressure pump is delivering the required oil to the feed motor for forward motion of the drill. Connected with the left line from the four-way valve to the feed motor, which is under pressure during the forward or feed rotation of the motor, is a flow-control valve for controlling the speed during the feed cycle by bypassing excess oil. This valve gives a uniform bypass flow for any particular setting unaffected by the pressure in the circuit. Connected with the same line is a pressure-relief valve, which can be set for various pressures so that a maximum pressure for the feed motor can be selected independently of the setting of other relief valves. This permits any desired feed motor torque and consequent thrust on the drill to be selected within design limits. A pressure gage connected to the relief valve is calibrated in psi and in pounds of thrust on the drill motor.

When the four-way valve to the feed motor is in neutral, approximately 5 gpm of oil up to 1,000 psi are available for operating the two hydraulic jacks through their respective lever-operated four-way valves. There are two pilot-operated check valves in the jack thrust lines, which definitely block the oil in the rear end of the cylinders until pressure is applied through the four-way valves to the front ends of the cylinders.

The drill mount is shown in Figure 3. The hydraulic drill motor is mounted on a 15-foot drill carriage and is attached to an endless chain drive. The feed motor and a reduction gear are mounted at the rear end of

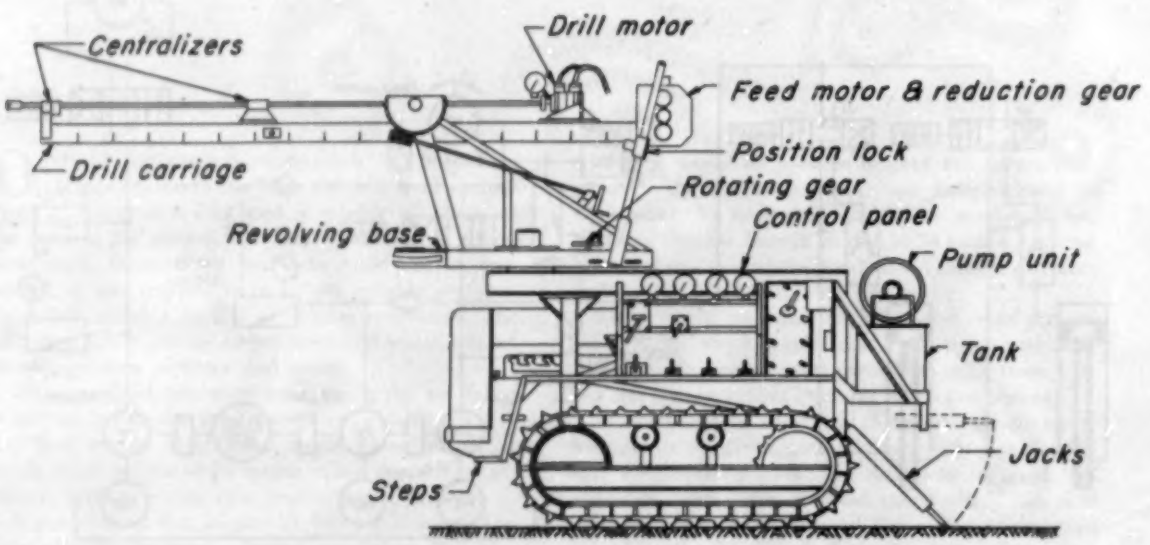


FIG. 3. THE COMPLETE *test drill is mounted on a track type tractor.*

Principal operating factors in rotary drilling are the feed rate and thrust of the feed motor and the rpm and torque of the drill motor. The hydraulic circuit is designed so that four possible combinations of these factors can be fixed.

the carriage. There are two centralizers on the carriage to prevent the drill rods from whipping or bending when under compression. One of the centralizers is at the front end of the carriage, and the other travels halfway between the drill motor and the front centralizer.

The drill carriage is pivoted on a revolving base near its center of gravity. A worm-gear drive allows adjustment of the drill carriage from vertical down to an angle of 30 degrees above horizontal. The revolving base is mounted on a trailer wheel bearing, which, in turn, is mounted on a structural frame secured to the tractor. A spur-gear segment and a pinion enable the revolving base and drill carriage to be rotated horizontally.

The pump assembly, including the three pumps, the electric motor, and the sump tank, are mounted across the rear of the tractor. On a control panel on the left side of the tractor are mounted the various four-way valves, the flow-control valves, and the pressure gages. An rpm indicator is mounted on the drill motor.

The four principal operating factors in rotary drilling are the feed rate and thrust of the feed motor and the rpm and torque of the drill motor. Feed rate and thrust are dependent on each other. Torque and rpm also are interdependent. For test purposes there are four possible combinations of factors that can be fixed for the test. These combinations are feed rate and rpm, feed rate and torque, thrust and rpm, and thrust and torque. The factors not fixed are then dependent on the type of rock being drilled and the drill bit. The experimental drill allows use of any of these combinations. For example, if the bit is to be tested at a given thrust and rpm, the pressure relief valve on the feed motor is set for the given thrust and the flow-control valve of the feed motor is closed so that all the oil is flowing through the motor. The pressure-relief valve on the drill motor is set at the maximum pressure, and the flow-control valve is set for operation at the given rpm. If the bit encounters rock that is hard to drill, or if the bit dulls, the feed rate may decrease and the torque increase, but the thrust and rpm will remain constant as long as the feed rate or required torque do not exceed their maximum limits. In the similar manner, any of the other possible combinations of operating factors may be fixed.

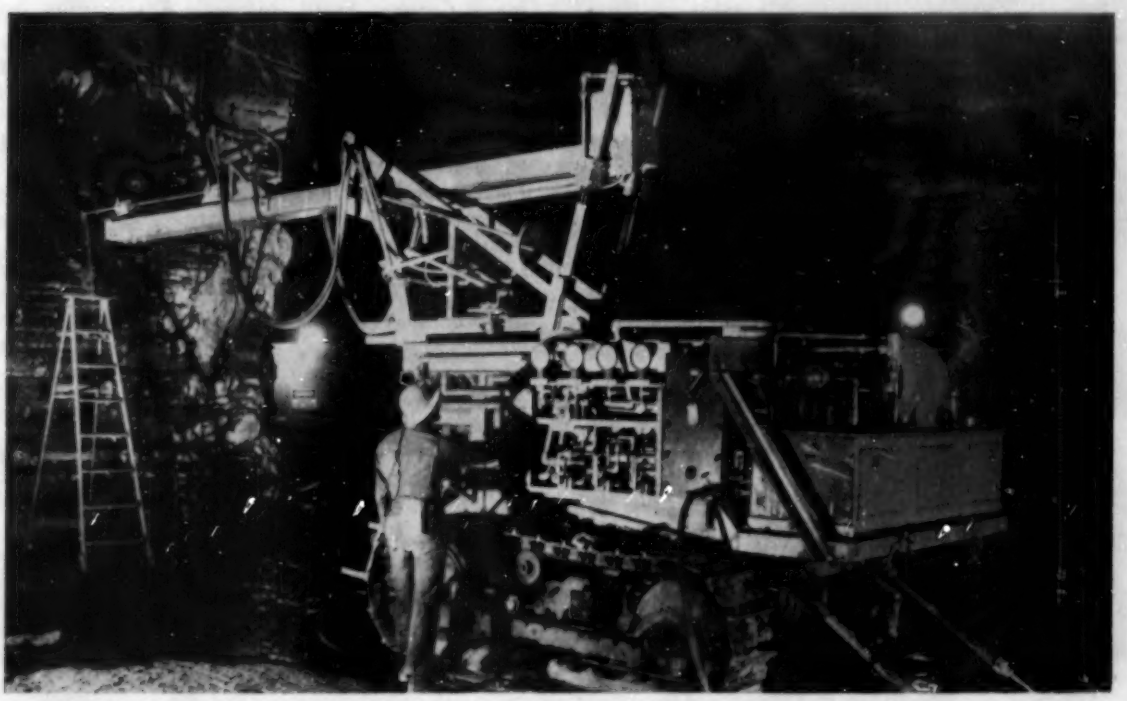


FIG. 4. THE DRILL *carriage can be swung into a horizontal drilling position.*

Carl E. Schmitz
Conference Director

• Plan to register early for this year's National Conference on Industrial Hydraulics being held at Chicago's Hotel Sheraton, October 14 and 15. Recognizing the growing use of complex pneumatic systems and their close relationship to hydraulics, this 10th annual program will include a session devoted to pneumatics.

10th ANNUAL HYDRAULICS CONFERENCE

...announces tentative program

CARL E. SCHMITZ, vice president in charge of sales for Crane Packing Company and Conference Director, has announced the tentative program for the 10th annual National Conference on Industrial Hydraulics, October 14 and 15 at the Sheraton Hotel, Chicago.

The NCIH is sponsored by the Illinois Institute of Technology graduate school and Armour Research Foundation of Illinois Institute of Technology, Chicago. The past year the National Fluid Power Association, the national association of manufacturers of hydraulic and pneumatic equipment, became the tenth cooperating society in supporting the NCIH.

Papers tentatively chosen for presentation include: *"Hydraulic Problems Encountered During Development of Engineer Equipment,"* by K. L. Treiber, chief, liaison branch, Engineer Research and Development Laboratories, Fort Belvoir, Va. *"Chrysler Power Flite Transmission,"* by W. R. Rodgers, supervisor, Mechanical Laboratories, Chrysler Corporation, Detroit. *"Power for Power Steering"*, by E. S. Witchger, sales manager, Pump Division, Eaton Manufacturing Company, Detroit.

"Unit Mounting of Pump and Control Units Directly on the Cylinder," by F. G. Cizek, assistant chief engineer, American Steel Foundries, Elmes Engineering Division, Cincinnati. *"Evaluating Piston Pumps and Motors for High Performance Hydraulic Systems,"* by R. H. Marvin, Franklin Institute, Philadelphia.

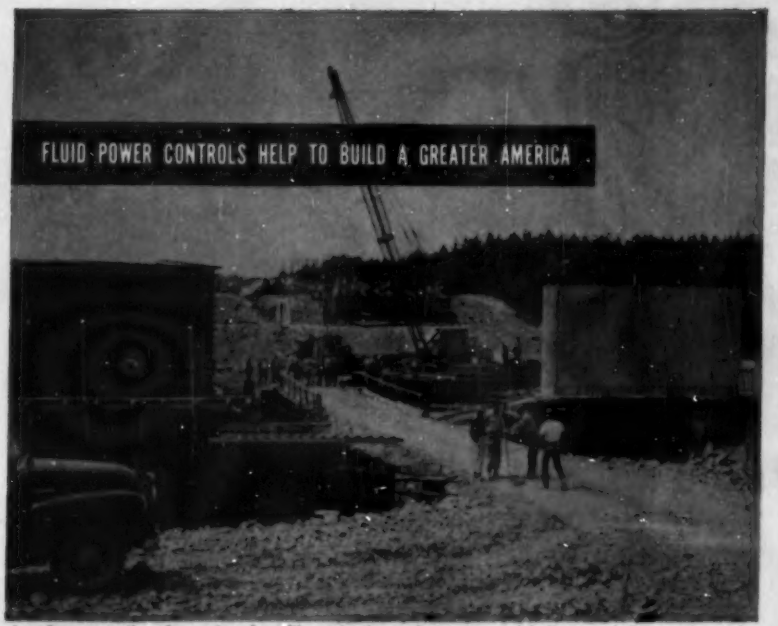
Servo Controls as Applied to Variable Displacement Pumps", by J. Wesley Broome, section head, Servomechanisms Department, Raytheon Manufacturing Company, Newton, Mass. *"Jet Engine Control"*, by J. M. Easton, research and development group, Bendix Products Division, Bendix Aviation Corporation, South Bend, Ind. *"Problems Encountered in Developing a Constant Speed Automatic Transmission for Aircraft Alternators,"* by R. G. Doolittle, group engineer, Development Engineering Department, Sundstrand Aviation, Rockford, Ill.

"Heat: Its Generation and Natural Dissipation in Hydraulic Circuits," by J. K. Douglas, development engineer, Oilgear Company, Milwaukee. *"Heat: Forced Convection Removal from Industrial Hydraulic Circuits,"* by D. W. Retzinger, contract products division, Young Radiator Company, Racine, Wis.

"The Use of Hydraulics for Machine Tools in Europe," by R. Richardson, general manager, Stein and Atkinson, Ltd., London, England. *"Hydraulics as Applied to Automation,"* by Walter Schroeder, project engineer, chief research engineering, Cincinnati Milling Machine Company, Cincinnati.

"Hydraulic Valves and Systems for Lift Truck Operation for Various Materials Handling Needs," by E. J. Hrdlicka, manager, Hydreco Division, New York Air Brake Company, Cleveland. *"Hydraulics Add Versatility to Modern Lift Trucks,"* by F. C. Schuster, chief engineer, material handling division, Buda Company, Harvey, Ill.

"Development of Valves for the Control of Pneumatic Power," by J. L. Shearer and S. Y. Lee, Massachusetts Institute of Technology, Cambridge, Mass. *"Flow of High Pressure"*, by M. M. Slawsky, head, pneumatics laboratory, National Bureau of Standards, Washington, D. C.



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AIR PILOT CIRCUIT

. . . actuates sliding stem valve

● By C. G. Lavers and N. C. Helmkay

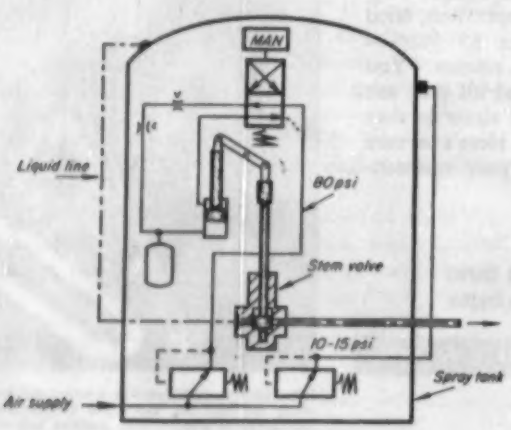
Selection of compressed air to power the sliding stem valve used on the portable unit shown in the illustration gives a safe, convenient-to-use device. The sanitation department of the Maple Leaf Milling Co. Ltd., Toronto, uses this portable rig to apply liquid fumigant in measured doses of 8 ounces.

Insecticide is poured into the modified low-pressure spray tank, which is then pressurized to 10-15 psi.

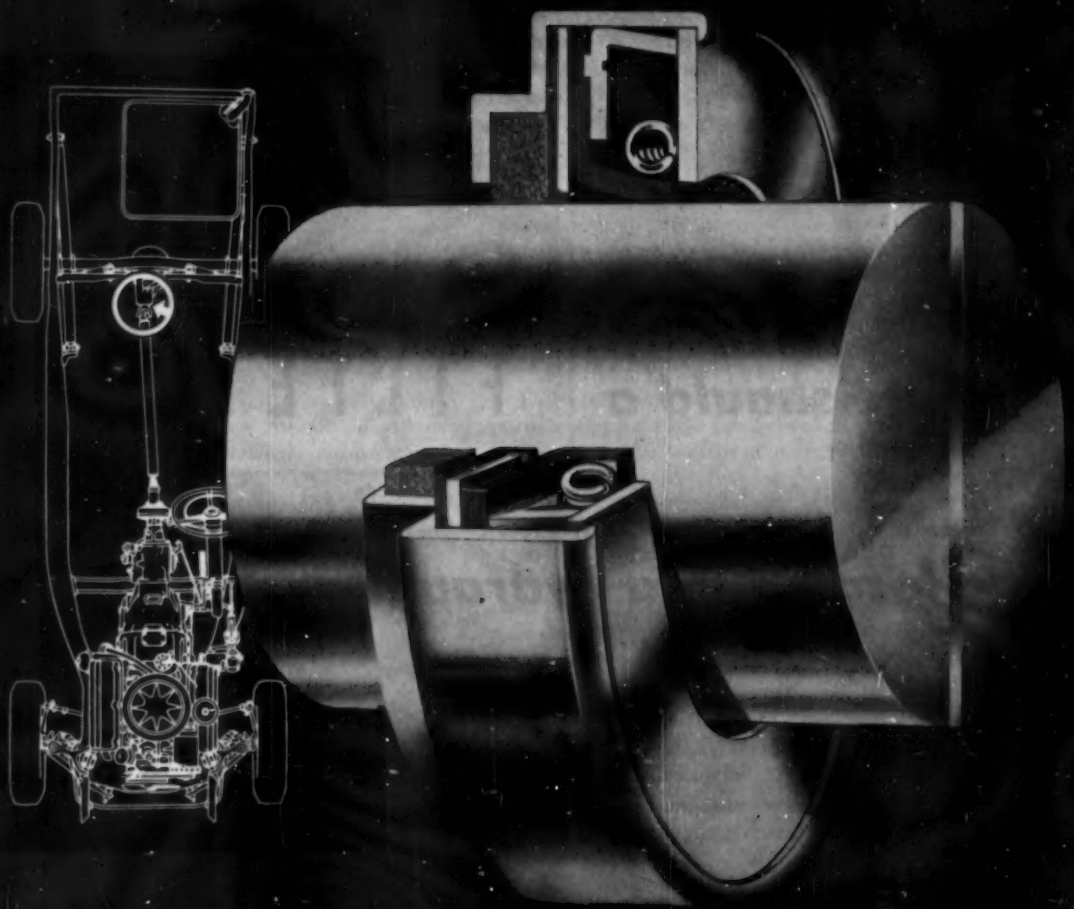
Air is admitted to the control mechanism at a pressure of 80 psi. When a shot of insecticide is required, the operator presses the push button on the 4-way valve and immediately releases it. Pressing this button admits air to the rod end of the double acting cylinder to open the stem valve. Immediate release of the 4-way air valve allows air to start bleeding through the flow control valves to the blank end of the air cylinder, to gradually close the stem valve and shut off the flow of insecticide automatically. The flow controllers are set so the correct quantity of insecticide is delivered. It was found necessary to use two air flow controllers in series and add a small reservoir to the line to get sufficiently accurate control of the discharge (+ or − 1 oz.).

Quick-connect air couplings which are used to attach the high pressure air hose in various places throughout the mill make the apparatus very portable.

TWO PRESSURE *regulators are used on this portable insecticide dispenser. One regulates air pressure acting on the fluid in the tank; the other regulates pilot pressure to operate the stem valve. The pilot circuit controls the amount of insecticide flow through the stem valve.*



Circle 23 on Reader Service Card



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Assistance in the preparation of this article was given by H. K. Woodward, The Briggs Filtration Company, James E. Duff, The Cuno Engineering Company, and J. R. McGuire, Waterman Engineering Company.

Where should a FILTER be located in a hydraulic system?

Just taking the step of installing a filter would pay tremendous dividends to a good many users of hydraulic equipment. The next step of installing the filter in the proper place requires study which will result in greatly increasing the value of your filtration equipment.

All oil hydraulic systems should be equipped with some type of filter to protect the hydraulic components and to help maintain proper machine operation. Filters may be installed in at least six different positions in a hydraulic system. Each installation has its merits and disadvantages. The choice of filter position depends on several factors:

1. Necessary degree of filtration
2. System pressure and quantity of oil flow
3. Quality and frequency of maintenance in the shop which uses the oil powered machine
4. Cost of the installation
5. Circuit layout and system design

Figure 1 illustrates six possible positions for filters on a hydraulic powered machine, 1) suction filter, 2) high pressure full flow, 3) bypass, 4) discharge from pump relief valve, 5) in system return line, 6) auxiliary unit.

SUCTION FILTERS

For the most part, filters located in the oil reservoir on the suction line of the pump must have a large mesh to keep the pressure drop at a minimum. A blocked suction filter will starve the pump. Suction filters provide full flow filtration. These are usually screen type filters which will remove particles down to .005 inch diameter when a 100 mesh filter element is used. When clean, these filters will offer an extremely low pressure drop between the oil reservoir and the suction side of the pump. A high pressure differential indicates filter clogging. Where space is limited, several suction filters can be connected to handle the necessary oil volume. Suction filters need not be submerged in the oil tank. On many installations, the line is carried outside the tank to permit "teeing" the filter into the line.

Micronic type filters are being used in some circuits on the pump suction side. They provide a higher degree of filtration than the screen filters; however, where large flows are required their size becomes troublesome. Also, because they give finer filtration, they require more service than the screen type suction filter.

BYPASS FILTERS

Although a fully effective full flow filter is desirable, in most installations it is not absolutely necessary. Experience has shown on many machines that if a minimum of 10 percent of the total flow through the pump is filtered continuously through a cellulose or activated clay type filter, the small particles passed by the suction filter will be removed.

The amount of oil being bled off can be maintained

by a fixed orifice or a pressure compensated flow control valve. Where wide variations of system pressures occur, the use of a pressure compensated flow regulator to maintain constant bleed off is advised. The bypass position enables the use of filters within a standard working pressure range regardless of the main system pressures. The bypass filter can be connected to any convenient high pressure line.

DISCHARGE FROM THE PUMP RELIEF VALVE

Installation of a filter on the discharge line to the reservoir from the main relief valve is sometimes convenient. The machine cycle must allow sufficient flow of oil through the relief valve to result in adequate filtration. This usually means that during idling the filter takes full flow from the pump. An additional low pressure relief valve or check valve is normally required.

Before this position for a filter is selected, a study of the circuit operation must indicate that any back pressure on the pump relief valve will not cause malfunction. Also, it is quite obvious, that this filter position should not be selected if the line from the pump relief valve is not easily accessible.

FULL FILTRATION FROM SYSTEM RETURN LINE

Placing the filter in the return line from the directional control valves provides full filtration of all the oil returning from work cylinders and motors. In order for this filter to be effective, the machine cycle must be such that there is oil flow in the return line during most of the time that the pump is operating. This would usually be the case when open center 4-way valves are in the circuit. If an anlysis of the machine cycle shows that the pump volume is circulating back to tank through an unloading or relief valve during most of the machine cycle, it would not be advisable to connect the filter to the return line from the 4-way valve.

Before selecting this position for the filter a study should indicate that there are no pressure surges in the return line which will exceed the designed pressures of the filter shell. The filter in this position will also create some back pressure. It must be determined whether or not this back pressure will be troublesome.

AUXILIARY FILTER

Full protection can be provided by using a small auxiliary pump and a low pressure filter which can be integral with the machine's hydraulic power system to give continuous filtration, or can be a portable unit which is used periodically to filter the entire contents of the reservoir. With this arrangement, the hydraulic system need not be shut down during service of the filter. This filtering arrangement is most widely used on large hydraulic systems where it is impossible to install a bypass filter of reasonable size. On installations where it is desirable to filter the oil before the fluid is picked up by the main hydraulic pump, this filtering method is very advantageous.

FULL FLOW FILTRATION ON PUMP PRESSURE SIDE

There are many circuits where the installation of a micronic filter on the pressure side of a hydraulic

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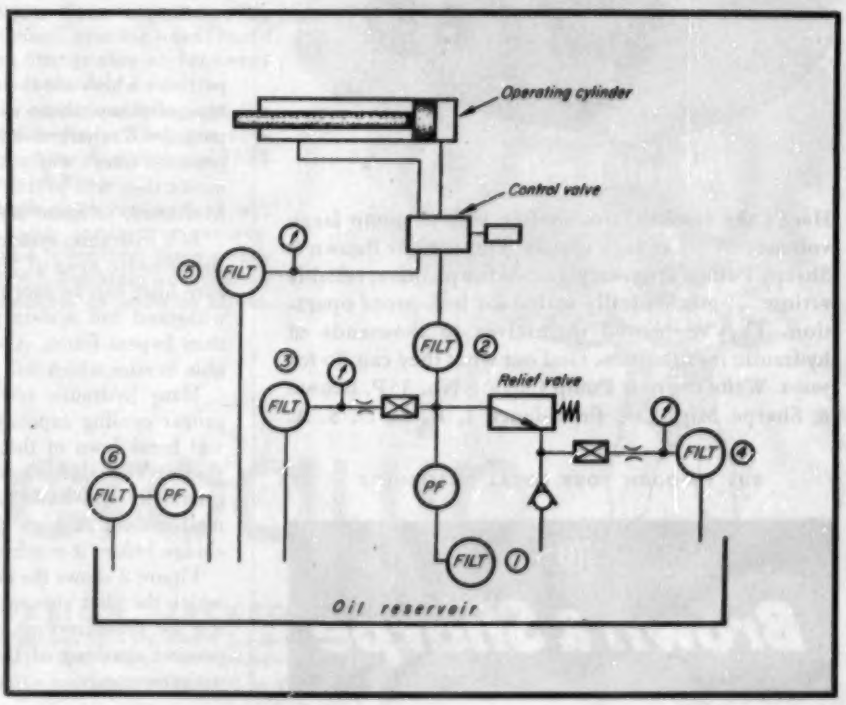

FIG. 1. SIX LOCATIONS *for the filter in a hydraulic circuit are shown in this schematic. Many circuits will have the suction filter plus a micronic filter in one of the other locations.*

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Where to Locate Filters . . . in hydraulic systems

pump is advisable. The source of trouble for many inoperative valves can be traced to fine dirt particles which cannot be removed by a screen type suction filter or by the partial filtration obtained with a bypass filter.

Where it is essential that production machines operate with a minimum of breakdowns, high pressure filters are a safeguard to the valve system. Some manufacturers of high pressure (2000-5000 psi) piston pumps recommend the use of suction filters which will remove particles down to .002 inch diameter and, at the same time, at least 20 percent continuous bypass filtration at 10 microns. This degree of filtration may still not be enough to protect valves. In such cases, a high pressure filter will provide the necessary protection. A high pressure filter also catches any fine

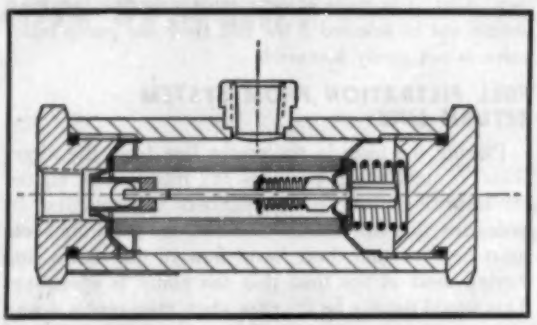

FIG. 2. CROSS-SECTION DRAWING OF *a full flow micronic filter used in the high pressure line from the hydraulic pump.*
Courtesy Waterman Engineering Company

particles which are the result of pump wear. With any type of pump, there will be wear which will result in particles discharged into the valve system. While high pressure filters will not protect the pump to any great extent they will protect the valve system which, in all likelihood, is more sensitive to fine particles.

In a hydraulic system operating at 1500 to 3000 psi, the pressure drop of 50 to 100 psi across a high pressure filter can be sacrificed. Because these filters must withstand full system pressure they are more costly than bypass filters. Also they are not presently available in sizes which will handle much more than 8 gpm.

Many hydraulic systems are not designed with the proper cooling capacity. This results in over heating and breakdown of the oil itself causing formation of sludge. This sludge can be pumped by the pump and eventually will build up in the valve system causing malfunction. A high pressure filter will remove the sludge before it reaches the valves.

Figure 2 shows the design of a high pressure filter in which the filter element can be removed without breaking the pressure lines. It has a built-in relief valve to prevent crushing of the filter element due to lack of maintenance.

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Trends in BRITISH Aircraft Pumps

Design and operation of both radial and axial piston pumps for high pressure hydraulic systems in modern aircraft are described

By John A. Lankester

During the postwar years there has been a significant increase in the pressures used for the actuation of landing gear retraction, flap operation and numerous other hydraulic services of modern aircraft. Since the pump is the heart of the hydraulic system, the evolution of high pressure circuits would have been impossible unless pumps capable of 3000-4000 psi were available. The design and manufacture of reliable, high pressure pumps has been of prime importance to the progress of the modern compact and powerful airplane remote control system. The evolution of such pumps makes an interesting study.

Prior to 1940 the average hydraulic pressure used in British aircraft was between 800 and 1200 psi, provided usually by gear or vane type pumps. The forerunner of the modern piston pump began to come into quantity production in 1940 and between that year and 1945, two types of radial piston pumps were extensively used on military aircraft. These were the Dowty Live Line pump and the Lockheed Mark V pump. Although both these pumps were of the positive displacement radial type, there were marked differences in design and operation.

The Lockheed Mark V pump contained seven stationary cylinders surrounding a central revolving cam. The Dowty pump contained a star-shaped cylinder block which carried seven pistons; the block rotated within a circular track ring, mounted eccentrically from the revolving star member-piston assembly. The pistons of the Lockheed pump were forced outwards to a circumferential delivery duct by a cam-member; in the Dowty pump pistons were forced inwards by the eccentricity of the track ring, displacing the oil towards the central fixed hub in which inlet and outlet ports were drilled.

A particular feature of the latter pump was that the eccentricity of the track ring was controlled by a leaf spring. When the rated pressure had been built up, the reaction of the pistons against the track ring overcame the spring loading and forced the pivoted track ring into a position concentric with the star member. In this position no stroke was imparted to

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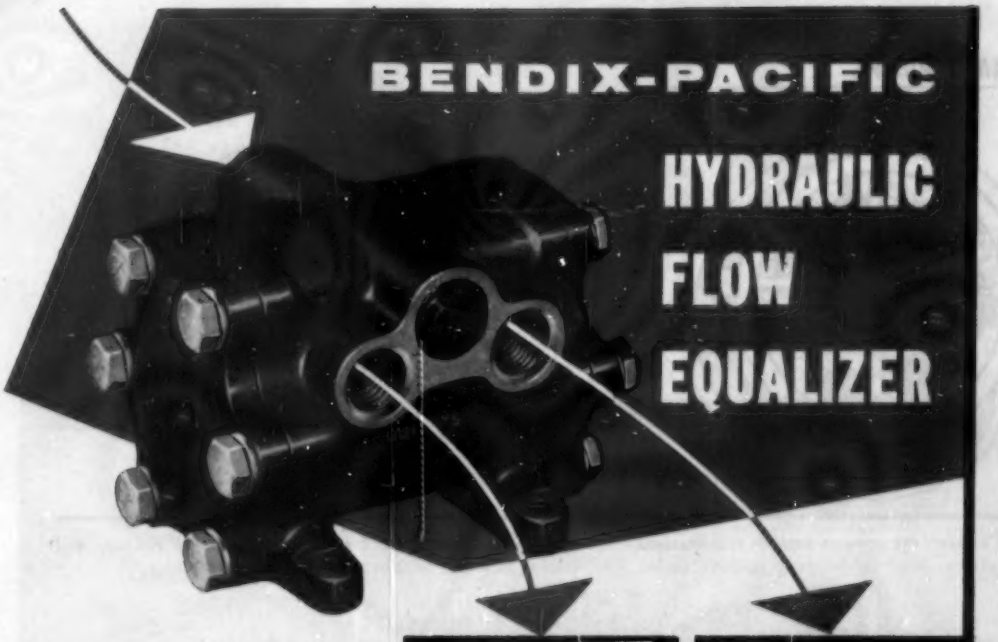

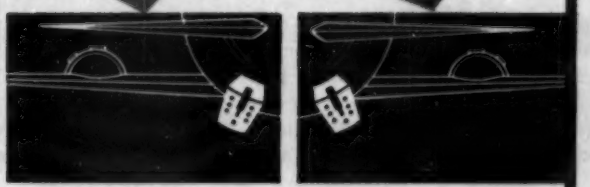

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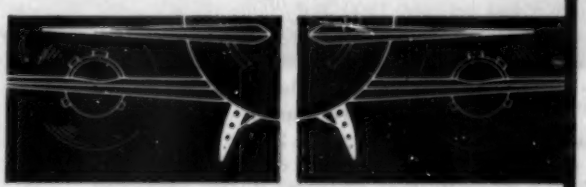

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FIG. 1. THE DOWTY *Live Line pump, a positive displacement radial piston type, shown (left) in pumping position (when track ring is eccentric pistons are caused to rotate), and (right) in idling position.*

the pistons and delivery ceased automatically. Thus, this pump was unique in that it was self-unloading and therefore required no cut-out, unloading or pressure relief valves. This feature went a long way towards simplifying hydraulic circuits and reducing them to three basic components: pump, selector valve and rams.

Figure 1 shows the pumping and idling positions of the Live Line pump. For aircraft purposes, the pressure generated by this pump was between 1800 and 2000 psi, although in certain instances this could be raised to 3000 psi by strengthening the leaf spring governing the eccentricity of the track ring. In certain heavy bomber aircraft of this period, the Lockheed Mark V pump operated satisfactorily up to pressures of 2500 psi in conjunction with a cut-out or off-loading valve set to bypass at this pressure. By the end of World War II British aircraft hydraulic systems were well on the way to the high pressures currently in use on aircraft.

The latest designs of British hydraulic pumps combine many of the features of their predecessors. A type now being manufactured by two leading hydraulic specialists in the United Kingdom is of particular interest. This type incorporates a combination of a low pressure gear pump used as a first stage to prime or supercharge a positive displacement piston pump.

Both of these designs, besides using the two stage principle, incorporate automatic unloading devices to allow the pump to idle at low pressure and minimum horsepower consumption after rated pressure has been reached.

This is achieved by permitting the low-pressure stage part of the pump to recirculate practically all of its delivery back into the inlet side: only a very small volume reaches the second, high pressure stage when idling, only sufficient in fact to compensate for small leakages (if any) from the high pressure lines or components. Thus the second stage takes care of pressure maintenance while the first stage is recirulat-

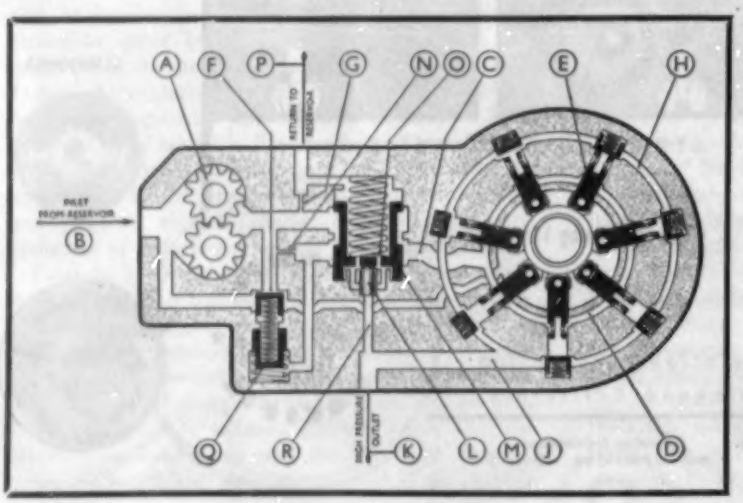

FIG. 2. TWO STAGE *displacement pump with automatic unloading valve to allow idling at low pressure and low horsepower consumption when rated pressure is reached.*

Courtesy Dowty Equipment Ltd.

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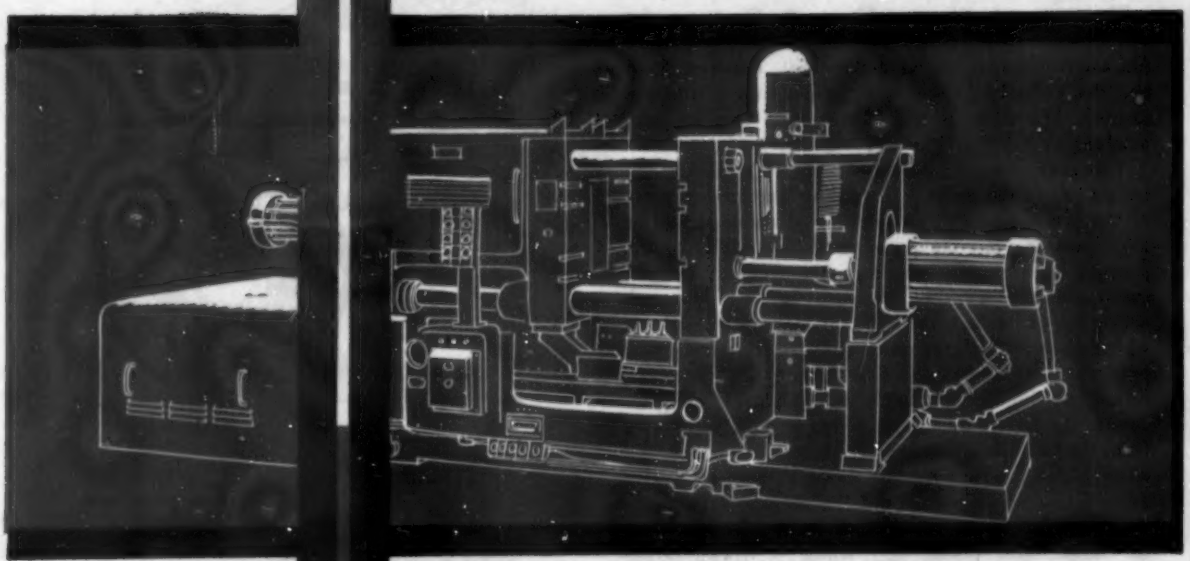

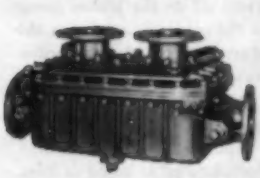

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ing and consequently, since the main volume is bypassed at low pressure (by stage one) the power consumption of the very small (stage two) delivery is at a minimum.

The primary circulation also cools the unit and by maintaining steady pressure to the second stage inlet avoids adverse effects of altitude on performance. Detailed descriptions and illustrations of these two leading British 4000 psi pumps, the Vardel and the Integral, are of interest.

The sectional diagram, Figure 2, illustrates the Vardel unit showing the built-in gear pump feeding the seven cylinder radial piston unit. Between these two the unloading valve and compensator piston are located. The main points of operation can be summarized as follows:

The gear pump (A) or first stage supplies oil, via passage C to the gallery D, feeding the suction ports of the piston pump (E), which provides stage two or high pressure oil, via passages H, J and K, to the selected circuits. After the completion of any service, the maximum working pressure is built up and, acting on piston L, moves the off loading valve (M), which shuts off the gear pump delivery from the piston pump except for a small flow through restriction N which, passing around valve M, maintains full pressure in the system during the idling period. Surplus oil from the gear pump, being unable to reach the second stage pistons, now bypasses through the relief valve (F). While deprived of fluid the second stage pump creates a depression which is ducted to the underside of compensator piston (Q) which is drawn downwards and permits increased flow through relief valve (F), thus reducing the power input required.

The effect is to reduce the power consumption of the whole unit when running in the idling condition. Any oil necessary to maintain full pressure in the system while the pump is in the off-load condition is provided through the restricted duct (N) passing across valve M to the second stage. It should be noted that, although pistons are operating in a condition of starvation, there is a passage to the cam chamber to provide for their lubrication by a portion of the low pressure stage oil. Because the gear pump output at all times exceeds the receptive capacity of the pistons, there is always a surplus of oil circulating back to the reservoir through restrictor G to insure heat dissipation.

Each cylinder of the Vardel pump is equipped with a spring loaded delivery valve to insure that high pressure oil does not feed back into the cylinder on its intake stroke.

Maximum pressure available from this pump is 4000 psi; at 3000 rpm the delivery is 6 gpm (U.S.). This delivery is constant up to 90 percent of the maximum rated pressure and thereafter falls to zero when 4000 psi is reached. At 3000 rpm, the provision of 4000 psi consumes 14 hp on load; once the unloading has been completed the power consumption falls as low as 1.1 hp. It is claimed that the Vardel pump is

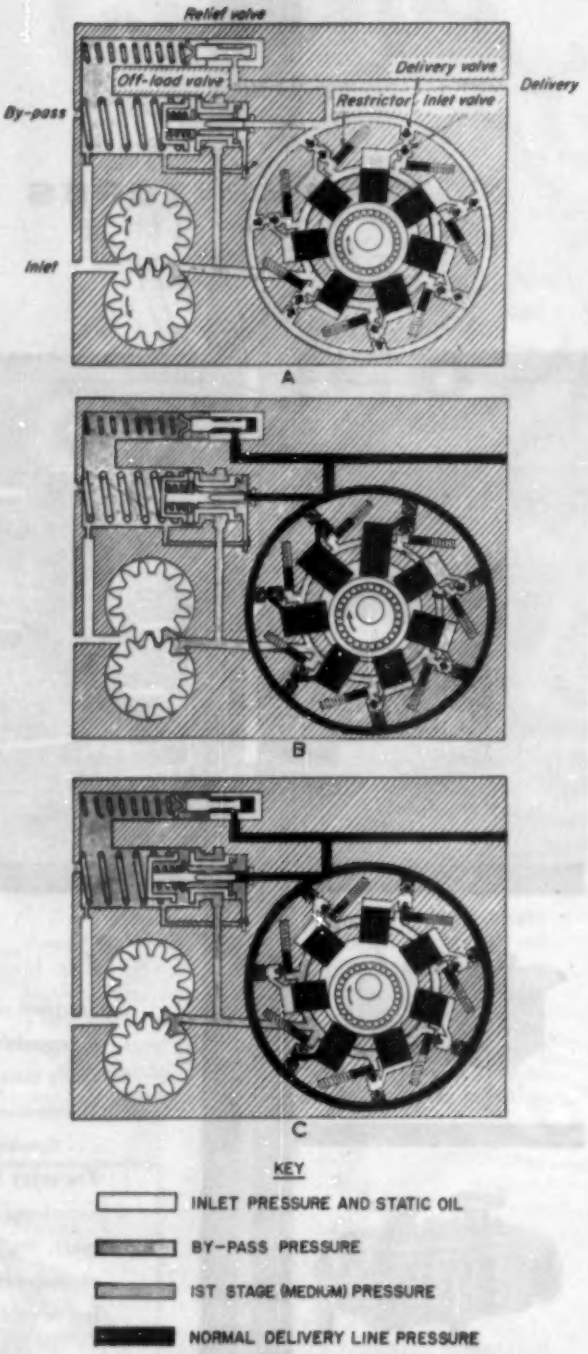

FIG. 3. THE INTEGRAL *pump bypasses low pressure oil without isolating the high pressure pistons. In medium pressure pumping (A) the gear pump delivers oil to the piston pump and disposes of surplus oil through the off-loading valve to the inlet side; at higher operating pressure (B), the proportion of first stage oil bypassed is increased as rising pressure lifts the off-loading valve further from its seat; at maximum rated pressure (C) all of the first stage oil is bypassed; to reduce the pressure required to hold the bypass valve open, the high pressure oil is admitted to a plunger located to assist in compressing the bypass main springs.*

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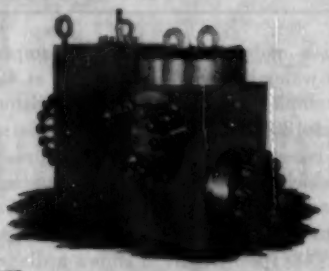

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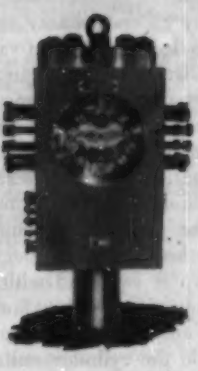

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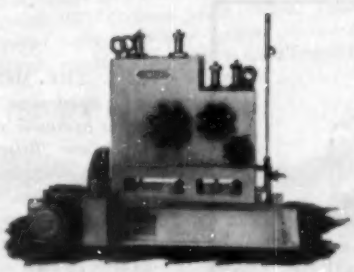

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Another example of the combined gear-piston pump is the Integral 180 Mark I, suitable for use with the conventional base hydraulic fluids up to pressures of 3000 psi at which pressure delivery is 5 gpm at 4000 rpm. The Mark VII variant of this pump has been designed to handle nonflammable fluids at a rate of 5½ gpm at 3000 rpm. Figure 3 shows a diagramettic view of the 180 Mark I pump. It is clear from the diagram, Figure 3, that the Integral pump bears a close resemblance to the Vardel pump. However, there is one important difference in the functioning of the off-loading mechanism. In the Vardel pump, the low pressure delivery is isolated from the high pressure pistons in the unloaded condition and, therefore, causes some starvation of the second stage; in the Integral pump the low pressure oil is simply bypassed without actually isolating the high pressure pistons. The following description and illustration makes this difference clear.

In normal medium pressure pumping (Figure 3,A) the gear pump passes oil to the piston pump and disposes any surplus (which amounts to about 12 percent) back through the off-loading valve to the inlet side. As the operating pressure rises, the proportion of first stage oil being bypassed increases as the rising pressure lifts the off-loading valve further from its seat. (Figure 3,B) When full rated pressure is achieved, the whole of the first stage oil is being bypassed (Figure 3,C) and to reduce the pressure required to hold the bypass open, the high pressure oil is admitted to a plunger whose function and location are such that it helps to compress the main springs of the bypass valve.

The restrictors shown in the diagram are included to prevent the excessive supply of fluid to the cylinders during off-load running, and also to prevent sudden

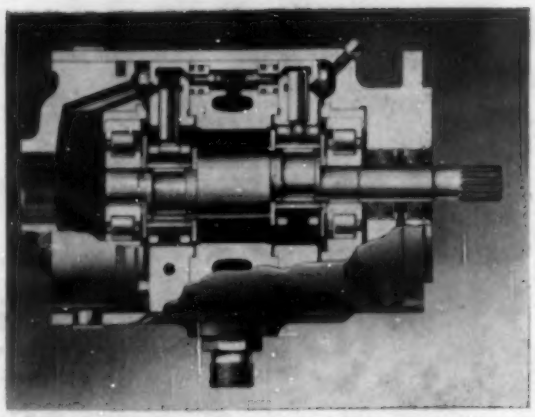

FIG. 4. SECTIONAL VIEW *of the Lockheed Mark 8 3000 psi radial piston pump. This pump employs two banks of cylinders radially disposed around a two-throw eccentric shaft. A cut-out or unloading valve must be used, since the pump does not have a built-in idling device.*

Figs. 3 and 4, courtesy Integral, Ltd.

fluctuation in the second stage delivery at around maximum pressure. Any excess delivery at the maximum oil pressure is handled by the relief valve located above the off-loading valve. Repeated oscillation of the off-loading valve is prevented by the incorporation of a restrictor in the passage leading to the back of the bypass valve. Variation of the degree of damping is provided for by an external adjusting screw. During idling, the circulating fluid from the low pressure stage cools and lubricates the pump in a manner similar to the Vardel arrangement. In the Integral design, the high pressure pump is equipped with both inlet and delivery valves, one pair to each cylinder. This is in contrast with the Vardel which has only delivery valves, the inlet ports in the cylinder walls being uncovered by the piston as it reaches the end of its suction stroke.

A simpler design of high pressure aircraft pump is

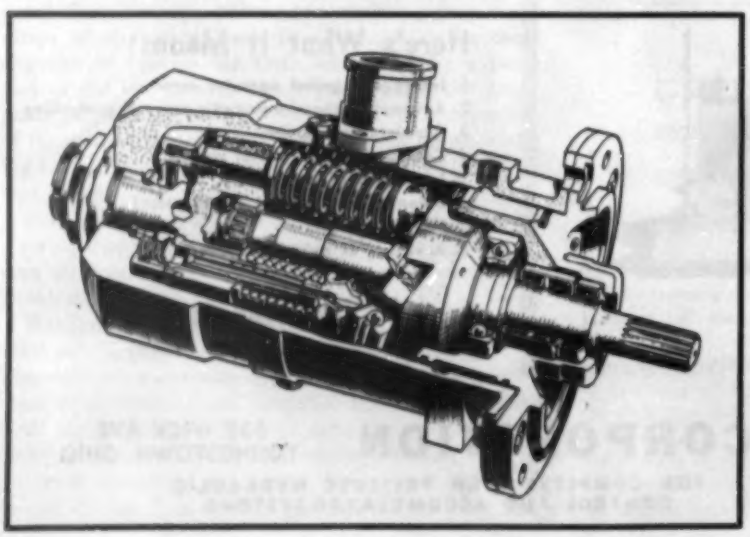

FIG. 5. THE MESSIER 4814 *axial piston, swash-plate pump powers the 4000 psi hydraulic system in the turboprop airliner "Bristol Britannia". (See November, 1953, issue APPLIED HYDRAULICS, page 92 and ff). Seven spring-loaded plungers are arranged axially. The swash-plate moves the pistons through their expulsion stroke; coil springs provide for the intake stroke.*

Courtesy British Messier, Ltd.

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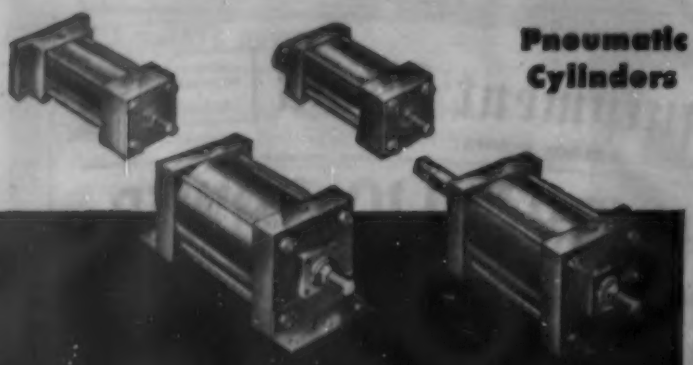

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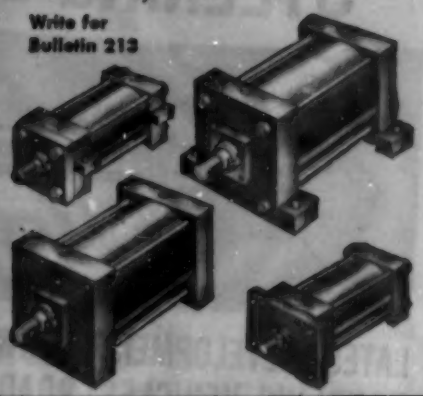

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represented by the Lockheed Mark VIII radial piston pump (Figure 4). This unit employs two banks of cylinders radially disposed around a two-throw eccentric shaft. The multiplicity of cylinders gives a smooth flow; at the rated speed of 3300 rpm the delivery is claimed to be completely free from pressure pulsations. At a pressure rating of 3000 psi and at 3300 rpm, delivery is 5.12 gpm (Imperial). At this speed and pressure the power consumption is 12.9 hp. This pump will operate satisfactorily with non-flammable and water-based fluids. Since this pump has no built-in idling device, a cut-out or similar unloading valve must be added.

In contrast with the radial piston pumps already discussed, one important axial piston pump must be mentioned. The Messier 4814 axial piston, swash-plate pump (Figure 5) is perhaps best known as the power source in the 4000 psi hydraulic system in the Bristol "Britannia". (See article, "4000 psi Hydraulic Circuit Designed for British Airlines", APPLIED HYDRAULICS, November, 1953). This pump is also used in a number of other British aircraft.

AXIAL PISTON PUMP DESIGN

In this design seven spring-loaded plungers are housed in cylinders arranged axially around the main body of the pump. Reciprocating motion is imparted to these pistons by means of a swash-plate rotated by the engine driven shaft. The swash-plate moves the pistons through their expulsion stroke; coil springs provide for the intake stroke.

In some radial piston designs the intake of the cylinders is through ports in the cylinder walls, in the axial piston design, as exemplified by the Messier design, small, flat plate valves are used. The hollow pistons are drilled down the center, allowing the oil to enter the cylinders past the plate valves located in the ends of the pistons themselves. On the delivery stroke these valves flap shut and oil is expelled past spring-loaded plate valves into the collector gallery from which the output is ducted to the delivery connection. Such pumps are usually capable of operating with equal efficiency in either direction of rotation. The swash-plate assembly incorporates an angular contact ball race which, in conjunction with the ground and polished spherical end-pads of each piston, minimizes the thrust friction between the swash-plate and pistons at high pressures.

Although the majority of British hydraulic pumps are driven direct from the engine accessory gear-box, provision is made in some cases for the unit mounting of the pumps on electric motors, for certain applications, where the electrically motorized pump is preferable. These motor-pump units can be conveniently cut in and out by means of pressure switches; this characteristic, together with the fact that they will operate independently of the main aircraft engines, makes them particularly suitable for emergency operation, both of the normal services and also of powered flying controls where the aircraft is equipped with this additional service.

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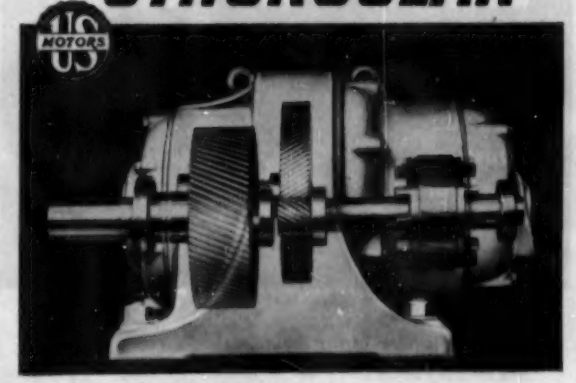

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Republic Opens High Temperature Lubricant Laboratory

The high temperature lubricant laboratory at Republic Aviation Corporation's Farmingdale, Long Island plant is one of the newest installations in the million dollar aviation laboratory. The job of this laboratory will be to proof-test—at various high temperatures and pressures—the operation of hydraulic fluids, lubricants, parts and packings for Republic aircraft. Tests at operating temperatures above 400F, a relatively unexplored field, will be important for Republic planes which will succeed the currect production models—the F-84F Thunderstreak, the first swept-wing fighter-bomber in the USAF and the photo-reconnaisance RF-84F Thunderflash.

The new lab is housed in its own two-room building. The most important piece of equipment, a heavily

FIG. 1. TECHNICIAN *H. M. Stanley is swinging the counterweighted 200 pound cover of the dual compartment thermal chamber into place. The counterweight also serves to ease displacement of the cover in event of explosive failure of hydraulic components. The chamber will be used to check operation of fluids and components in aircraft hydraulic systems at high temperatures and pressures.*

insulated dual-compartment thermal chamber, takes up most of the usable space in one of the rooms (54 x 57 x 89 inches). In each compartment is an inner box; one measures 40 x 40 x 36 inches, the other 36 x 24 x 22 inches.

The inner boxes, into which parts are placed for test, are made of one-sixteenth inch steel sheet; hinged doors are fitted with clamps; steel covers are removable. When the covers are screwed down for tests, screws fit through slots in each cover so that the cover would give way readily in the event of explosive failure of the part being tested. This arrangement also helps guard against damage to the test compartment.

The inner boxes fit inside larger steel boxes to provide two inches of air space on all sides. Electric heaters, mounted on asbestos boards, are installed in this air space between the boxes. Automatic thermostatic control of these heaters in conjunction with water cooled heat exchangers outside the thermal chamber,

maintains accurate test temperatures. Heated air is circulated in the air space outside the box by a centrifugal blower and, on the same shaft, by a fan in each inner box. Nitrogen is bled into the air space, providing an inert gas blanket to minimize fire hazards.

THERMAL INSULATION

The double walled compartments are insulated on the outside by six inch layers of a calcium silicate block with a fibre binder. The outer surface is aluminum sheet.

Cover lids of the thermalchamber are also six inches deep. Covers fit snugly into the outer chamber on a ledged mounting. Heavy, (one cover weighs 200 pounds, the other 300 pounds), the covers are connected to counter-weights through pulleys, to facilitate handling and to enable the covers to unseat and then settle back into place in the event of explosive failure of a test component. This arrangement also protects the test equipment as well as the lab personnel.

Two doors, along one side of the thermal chamber, give access to the inner boxes. A hinged door, 34 x 32 inches, and a second door, suspended by a movable arm at the ceiling, both six inches thick, are sealed by toggle type clamps. Tests in progress can be watched through the triple panes of the outer doors and the single panes of the inner box door. The glass is quarter inch heat treated glass with intervening air spaces. When observations are not being made the outer windows may be covered by asbestos board covers.

Four openings of various sizes run through the thermal walls into each of the inner boxes, providing access for electrical, hydraulic and pneumatic connections to the test equipment for instrumentation and control.

TESTING OIL CYLINDERS

Initially, the thermal chamber will be used for testing high temperature hydraulic systems. While being tested, cylinders will work against other hydraulic cylinders located outside the thermal chamber. An eight-inch H-beam framework built around the thermal chamber about one foot above the floor has

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OPERATION

- **A** Spring Offset, Two Position, Solenoid Operated, Four Way Valve using engine oil to operate hydraulic cylinders.
- **B** Solenoid energized, 3000 psi at inlet port produces outflow at cylinder 1—cylinder 2 open to return.
- **C** Solenoid de-energized, produces outflow at cylinder port 2, cylinder 1 open to return.

CHARACTERISTICS

1. Ambient temperature range —65° to +350°F.
2. Operating pressure 3000 psi.
3. Ports per AND10050 are available in 1/4", 5/16", 3/8", and 1/2" tube sizes.
4. No packing on sliding members.
5. Operating voltage 18-30 VDC.
6. Current required 1.0 amp. at 30 volts.
7. Continuous duty solenoid.
8. Pilot valve spring loaded against pressure to 4000 psi min.
9. Operating fluid MIL-L-7808.
10. None interflow type valve.
11. Weight 1.75 lbs.

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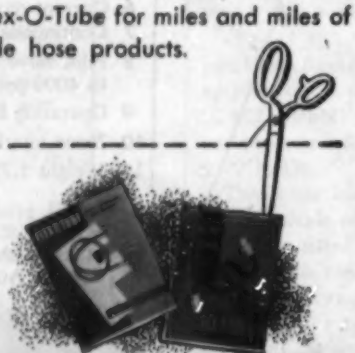

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REPUBLIC AVIATION OPENS HIGH TEMPERATURE LAB

Continued

been designed to carry the loads exerted by the cylinders.

Teflon seals are used for the piston rods, window frames and other connections.

The use of two compartments in the thermal chamber will permit Republic researchers to duplicate flight conditions quite closely. Pumps and reservoirs inside high

FIG. 2. WINDOWS *in inner and outer doors permit observation of tests. Engineer W. Z. Prickett holds the triple-paned window. Loads of hydraulic cylinders being tested are carried on the structural steel H beams which surround the thermal chamber.*

speed aircraft probably will operate at lower temperatures than those of hydraulic components near the surface of the airplane. This, in fact, is one of the critical problems of high speed flight and is due to the high skin temperatures generated by the friction of high speed flight. Inasmuch as different temperatures can be maintained simultaneously in the two compartments, realistic temperature conditions simulating actual flight.

In the second room of the new lab, two hydraulic test stands, with insulated reservoirs, electric heaters and facilities for loading and operating hydraulic components, are used for conducting preliminary screening tests.

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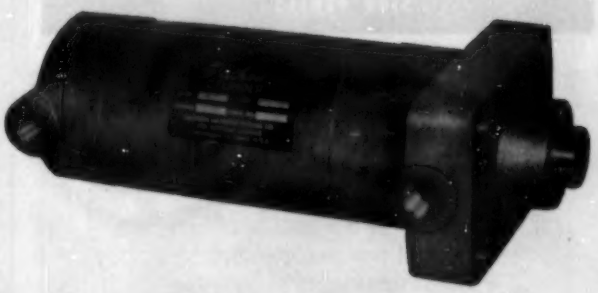

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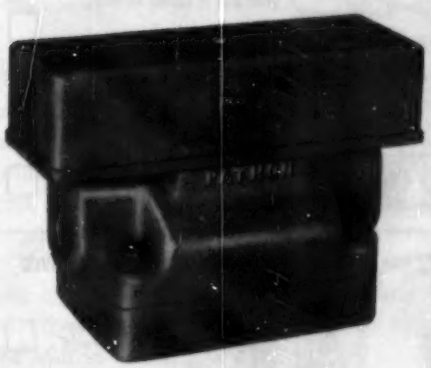

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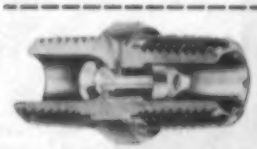

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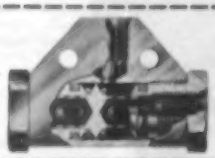

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Concluded from page 34

tracting cylinder. Any or all of this sequence may be performed manually or automatically.

SMALL HYDRAULIC RAM

This ram is identical to the large ram in construction except that the area of the platen is smaller. A smaller shutter is used and the photoelectric control is eliminated. The selection of three speeds is provided as well as the automatic slow speed start and stop and other features. Since the shutter for this ram is located at the ceiling level of the process cell, safety limit switches are provided that restrict the ram travel until the shutter is fully open.

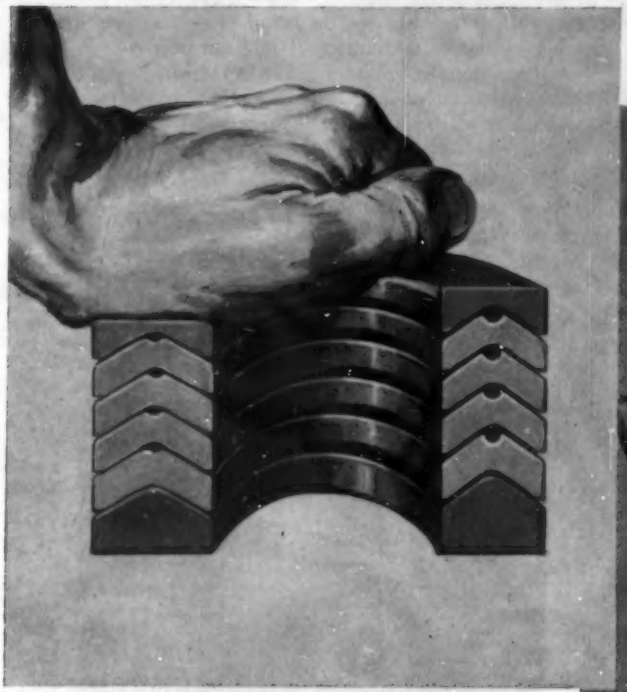
The exact locations of the rams are indicated at all times at the six control stations and the master console. A selsyn generator mounted adjacent to the piston in the hydraulic equipment room is rotated by a roller chain attached to the moving cylinder. Receiver selsyns at each of the stations are geared to mechanical counters. The slightest rotation of the selsyn generator, due to movement of the ram, causes the receiver selsyns to rotate an equal amount. The gear ratio of the system is such that the counters register in inches of travel with an accuracy of 0.1 inches.

The shutters of both rams may be set to operate automatically or may be opened and closed at will by the operator. Four double-acting hydraulic cylinders, supplied from gear type flow dividers, power the split shutter over the large ram. One double-acting hydraulic cylinder furnishes power for the small shutter.

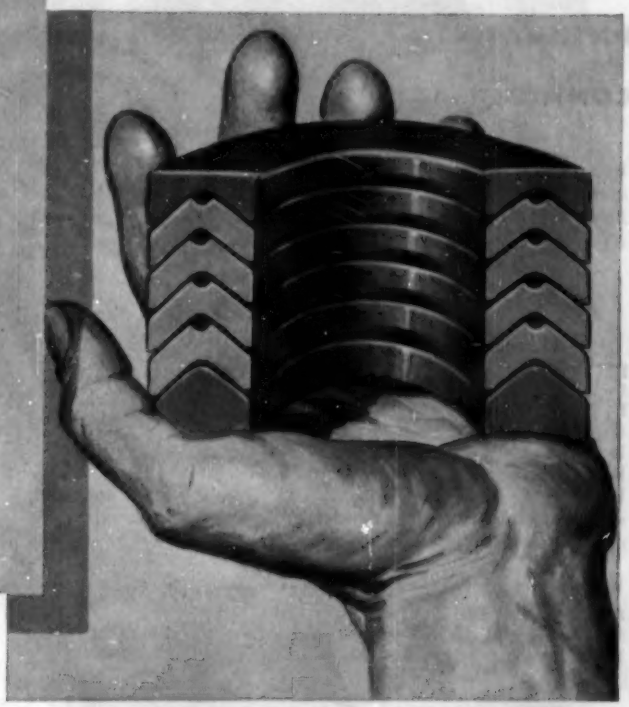
Since failure of any part of this hydraulic system at a crucial time could be very troublesome, elaborate precautions are taken. These include conservative design, extensive acceptance testing, duplication of facilities, installation of all piping and equipment for easy maintenance, and provision for by-passing any or all components through manually operated valves. Any component that is inaccessible due to its hazardous location is designed with an ultraconservative factor of safety. Several months of shakedown testing, including full load and pressure tests, were conducted before acceptance. An emergency electrical power supply which automatically functions during a power outage is supplied. Also, two additional pumps and electric motors of the same capacity, that normally supply hydraulic power for another system, can be used on this system at a moment's notice.

The satisfactory performance of this elaborate system under all operating conditions indicates the inherent advantages of a well designed and carefully constructed hydraulic assembly that is capable of handling large loads with great precision and smoothness. Present indications are that a minimum of maintenance and repair will be required for years of successful operation. To date, there has been no apparent radiation damage to the hydraulic fluid or to any hydraulic components.

See for yourself how U. S. Matchless Packing reduces wear on rods, reduces packing costs



This demonstration set of U. S. Matchless has been cut in half. When set is squeezed by hand, note how the lips spread out. Then note what happens when the pressure is released...



When pressure is released, the lips retract. This action duplicates what happens when U. S. Matchless is subjected to hydraulic pressure *plus* subsequent release, as on a reciprocating rod or hydraulic ram.

The photos above show how pressure (whether gas or fluid) forces the double pliant lips of U. S. Matchless® Packing against the rod and side of the stuffing box. *This self-adjusting, automatic action plus the blunt edge design reduces wear on the rods, prolongs packing life and hence lowers maintenance costs.*

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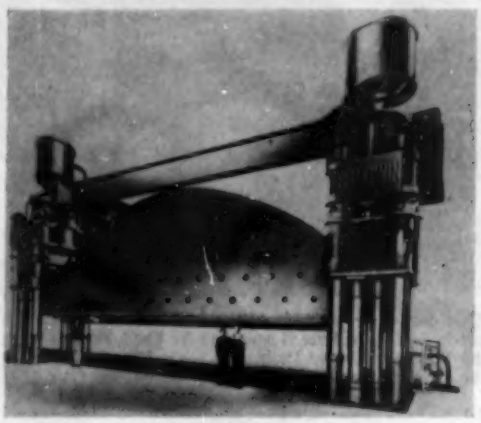
THE 8,000-ton hydraulic beam press at the new Foster Wheeler plant at Mountaintop, Pa., has a remarkable effectiveness in handling heavy steel plate, hot or cold. Built by Baldwin-Lima-Hamilton, the press is one of the largest of its kind ever made. It can bend hot steel plate eight inches thick, or lighter plate up to 40 ft. long into half shells, which, when welded together, will form the largest and heaviest pressure vessels.

The press is hydraulically operated, using the simplest type of circuit, which is aided by valves and pressure gages, to protect the system against overloading. Control of the speed of the moving beam is at the discretion of one operator. Such control is accomplished by means of a single lever, the position of which determines the speed and direction of motion: up or down. This is effected by a mechanical linkage between the operator's lever and four radial piston pumps, of the reversing type, coupled to two 200 hp double end motors.



FOUR RADIAL PISTON *variable volume reversing type pumps power and control this* 8000 *ton press.*

Actually, the structure combines two four-column presses in one, each with a capacity of 4,000 tons. The two sets of columns are coupled together by laminated steel beams—one set attached to the bottom platen and one to the moving platen—to form a single unit capable of exerting loads up to 8,000 tons on the plate to be formed.

Each of the 4,000-ton sections consists, essentially, of a cast steel main cylinder, moving platen, pushback cylinders, and equalizer cylinders. The columns are shoulderless, and of a straight-through design that permits removal of any one of them without completely dismantling the press. The steel columns are assembled to the main cylinder by means of split cast steel nuts at the lower extremities and split steel collars set into a counterbore in the upper surface of the bottom platens. In this way, any of the columns may

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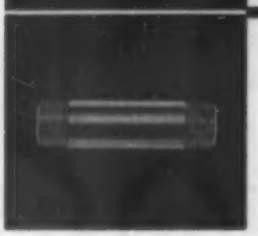

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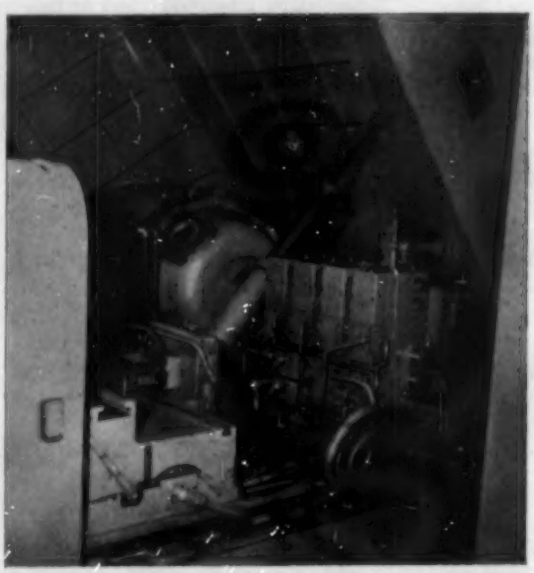
be removed by drawing them up through the main cylinder column husks.

The presses are designed to provide daylight of 96 in. maximum between the lower surface of the upper bending beam and the upper surface of the lower bending beam. All rams have a maximum stroke of 60 in. Maximum operating speed under no-load conditions, up or down, is 82 in. per minute; maximum pressing speed is 12 in. per minute up to 8,000 tons.

To facilitate handling of the hot steel plate, there is also a unique hydraulically powered plate handling device which positions the plate to be formed, easily and with minimum loss of metal temperature. Especially designed by Baldwin-Lima-Hamilton, the plate-joggling mechanism will handle plates up to 40 tons each. It consists of four 7 in. diameter lift cylinders, eight 3¼ in. diameter manipulating cylinders, rollers, push rods and pins. The push rods are hinged for back and forth movement on a vertical plane. Vertical stroke of these rods is 13¼ inches. The lifting pins have a horizontal movement of 3 in. to either side of the vertical centerline. The positioning toggles, hydraulically operated, are built into the lower press beam. A 7 gpm, 2,000 psi, vane pump, directly coupled to a 7½ hp motor, operates the device.

Cylinder Operated Guard Reduces Fatigue



This mammoth guard is used at Ford Motor Company's Cleveland plant to keep dirt out of the operating controls of a crankshaft grinder. Lifting it manually would be a back straining task. Instead it is raised with a hydraulic cylinder. A mechanical dog safety catch prevents accidental lowering of the guard while workers make machine adjustments. The catch is manually positioned and released by the worker.

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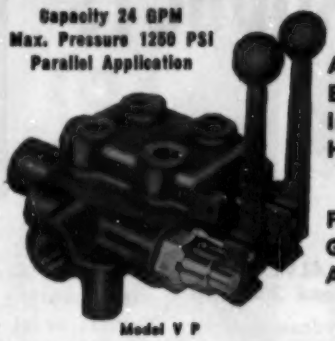

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- ✓ BENDING
- ✓ TAPPING
- ✓ RIVETING

GRIPPING FORCE 15 TIMES AIR LINE PRESSURE

Speedy Air Vise helps you do dozens of operations faster, better, cheaper—by air pressure! Foot control valve opens and shuts vise instantly, leaving *both* hands free to produce *more!* Jaw opens up to 5 inches, holds castings, parts, jigs, etc. Compact and trouble-free.

Complete with Foot Control, Air Hose and Fittings. . . . . . only **$36.00**

Prompt Delivery from Your Supplier or Write Direct

W. E. BROWN CORPORATION • 2655 N. Normandy Ave. • Chicago 35, Ill.

AIR REGULATORS • AIR FILTERS • AIR GUNS • PORTABLE COMPRESSORS

Circle 67 on Reader Service Card

Circle 20 on Reader Service Card

NEW PRODUCTS

Components, tools and equipment designed to improve operation of fluid power systems are described here . . . for more information fill in and mail the post card bound in this issue.

Continued from page 30

ROTARY PLATE VALVES . . . for 1500 and 3000 psi

Design: These hydraulic non-interflow valves incorporate two optically true hardened

steel plates, which virtually eliminates all leakage between ports. The valves are housed in an alloy aluminum body which decreases weight. The ¼ in valve weighs only 16 oz. Designed in accordance with MIL-V-5529A.

Pacific Division,
Bendix Aviation Corporation,
North Hollywood, Cal.
Circle 205 on Reader Service Card

AIR OR HYDRAULIC CYLINDER . . . for small clamping jobs

Design: Cylinder has design features which give it considerable durability in continuous operation. The cylinder is of all steel construction except for bronze bearings and synthetic piston packing. The packing gives the cylinder a range of successful operation between –55 to 250 F. The standard unit has a universal mount allowing threaded nose, foot, front or rear flange mounting. Pivot, trunnion, clevis mounting are available on special order. Styles available: single acting, spring return and

double acting in 1 and 2 in strokes.

Applications: Toggle operations, spring return motions, die set strippers, pilot operation of valves, opening of die sets, multiple holding and clamping operations, jigs and fixtures.

Carter Controls, Inc.,
Lansing, Illinois
Circle 206 on Reader Service Card

INDICATING GAGE . . . fully adjustable

Designation: Snap Gage
Size: Two sizes, to cover, up to 6 in range

Design: Gaging contact buttons and anvils permit positive gaging, although indicator does not come in contact with the part being gaged. Gaging contacts are quickly removable and replaceable with other types for varied gaging requirements.

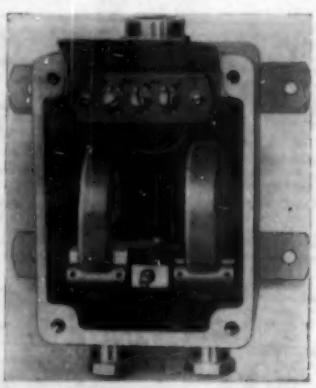
Features: .0005 dial indicator. Contact ½ in dia hardened and ground steel with polished spherical radius.

Applications: May be used for precision inspection of large outside or inside diameters and lengths.

Reliant Industries,
South Gate, Cal.
Circle 207 on Reader Service Card

PRESSURE SWITCH . . . fully enclosed

Designation: Model 532
Design: Tamper-proof external



adjustment is provided for field setting. Unit incorporates an approved snap action, single pole, double throw switching element rated for ac and dc circuits.

Features: Senses a pressure difference between two variable pressures or a variable and a reference pressure. Available in 4 classes of proof pressures from 500 to 12,000 psi. Switch permits opening or closing of a circuit on increasing or decreasing pressure difference from 15 to 10,000 psi at any point within the adjustable range of the mod-

Circle 82 on Reader Service Card →

For all kinds of hydraulic lubrication...

for hydraulic jacks on stripping shovels

for lift trucks

for machine tools

6 ways better...

In all types of hydraulic systems, STANOIL Industrial Oil assures cleaner, smoother operation . . . with longer oil life! STANOIL assures you superior lubrication through the unique combination of these six characteristics: **1.** *unusually high stability:* special refining techniques and the addition of an effective antioxidant provide unusual resistance to chemical change. **2.** *effective rust prevention:* an advanced type of corrosion inhibitor acts to prevent rust and corrosion troubles by "plating out" on metal surfaces. **3.** *low pour point:* a special additive increases free-flowing efficiency for starting cold equipment. **4.** *high viscosity index:* provides smooth operation regardless of widely varying temperatures. **5.** *excellent demulsibility:* eliminates emulsion problems . . . contains an additive to minimize foaming tendencies. **6.** *low carbon-forming tendency:* reduces carbon deposits that cause valve-sticking and wear.

STANOIL Industrial Oil

Put this 6-ways-better oil to work for you today. For complete information call in a Standard Oil lubrication specialist. In the Midwest, you can reach him at your nearest Standard office. Or write to Standard Oil (Indiana), Chicago 90, Illinois.

STANDARD OIL COMPANY STANDARD (*Indiana*)

Continued

el selected. Two parallel bourdon tube sensing elements provide extreme repetitive accuracy for the control of the most delicate processes or the protection of sensitive instruments and costly equipment. Operates in any position simplifying installation and facilitating portable installations.

Applications: Operation of relays, solenoids, motor controls and other similar devices on oil powered machines.

Barksdale Valves,
Los Angeles 58, Cal.

Circle 208 on Reader Service Card

WATER VOLUME CONTROL
. . . maintains set flow rate

Designation: Mesurflo
Size: ¼, ⅜ and ¾ in pipe sizes
Design: A water flow volume control designed to maintain one set flow rate regardless of variable inlet pressures. This control will automatically compen-

sate for surges in line pressure and pressure drop is preset to deliver one constant rate anywhere between .2 gpm and 14 gpm. Will maintain operating accuracy of 10 percent within the variable range of 15 - 150 psi.

Industrial Sales Division,
Hays Manufacturing Company,
Erie, Penn.

Circle 209 on Reader Service Card

FILTERLESS PURIFIER
. . . removes dirt, moisture

Designation: Type LC Hi-ef
Size: Made in a wide range of sizes for installation in any size piping when used in a vertical position and made in 1 in through 2 in sizes when installed horizontally.
Construction: Unit removes dirt

and moisture by means of a combination centrifugal and baffle-type separating element inside a forged steel body. This eliminates the need for any filters. Once the unit is installed on the air line near the pneumatic equipment, there is no necessity of periodically cleaning the unit, or even inspecting it. Liquids and solids are drained automatically from the purifier.

The V. D. Anderson Company,
Cleveland 2, Ohio

Circle 210 on Reader Service Card

REPUBLIC
"LO-TORQ"
SELECTOR VALVE

0-6000 psi SERVICE with
LOW TURNING TORQUE

Exceptionally low turning torque is obtained by "floating" the valving disk in the service fluid, thereby balancing the pressure and eliminating thrust bearings . . . a sound application of the hydraulic engineering principle that fluids under pressure exert force equally in all directions.

Sealing rings on both sides of the selector disk eliminate leakage at all times whether pressure is forward, back, or off entirely.

For air and gas service, 0-1000 and 0-3000 psi; for fuel, hydraulic oil, petroleum, and water service, sizes ⅛" to 1", 0-2000 and 0-6000 psi. 2, 3, and 4-way.

Write for catalog no. 454 for complete information.

Distributors in principal cities from coast to coast.

- 0-6000 psi service
- Low turning torque
- Panel mounting
- Semi-steel, bronze, aluminum alloy
- No leakage at any time
- 3 types of portings

RM
REPUBLIC MANUFACTURING CO.
15655 BROOKPARK ROAD • CLEVELAND 11, OHIO

Circle 74 on Reader Service Card

Make your O-Ring Dollars Go Farther!

Stillman's Top Quality Industrial O-Rings Cost Less!

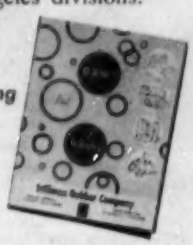
Here's great cost reduction news from Stillman!

Now, a new top-quality series of Stillman Industrial O-Rings for general industrial hydraulic fluids, as well as water and air service, enables you to stretch your O-Ring dollar without sacrificing quality.

These remarkable O-Rings, precision-molded of Buna N fuel and oil resistant compounds, were developed in our laboratories after extensive study and tests. Available in a complete range of standard sizes, as well as special sizes for industrial use, they seal better, last longer—yet cost no more than any industrial O-Ring you can buy. And each Stillman Industrial O-Ring is precision made to the same high standards of accuracy and quality that mark all Stillman products.

Whether standard or special, your Industrial O-Ring requirements get double-quick service from our Cleveland or Los Angeles divisions. Investigate these new Stillman Industrial O-Rings today!

Write for our illustrated O-Ring folder. It's full of helpful information.



STILLMAN RUBBER CO.

23525 Lorain Rd., Cleveland 26, Ohio

5811 Marilyn Ave., Culver City, California

Continued

PNEUMATIC TEST STAND . . . has burst proof chamber

Construction: Composed of three units, the compressor, moisture eliminator and stand proper. The air compressor is a four stage, tandem unit which is belt driven at 225 rpm by a 30 hp induction motor and is rated for 30 cfm and 6000 psi. The moisture eliminator is a semi-automatic dehumidifier with dual absorber units for continuous drying action. The stand is a sturdy steel housing which contains the instruments, controls and test chamber. The chamber is provided with transparent view ports, can contain an explosion of a 400 cu in air receiver at 5000 psi.

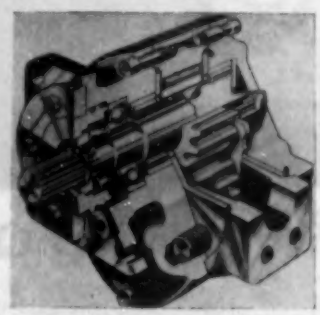
Features: Several features have been engineered into the stand to insure maximum safety to shop personnel. Components are tested in a burst proof chamber whose view ports are 2 in bullet proof glass. A special air release baffle is incorporated which is able to contain the force of explosion yet catch any fragments. Safety doors interlock with a pressure switch, making it impossible to open the door while components are being tested.

Greer Hydraulics, Inc., Brooklyn, New York

Circle 211 on Reader Service Card

OIL HYDRAULIC PUMPS . . . are pressure balanced

Design: Heavy-duty bearings take up the pressure loads with less wear. Specially designed rotary shaft seals eliminate any pressure bleed back. Anti-friction roller bearings carry a 1500 psi load at speeds up to 2000 rpm. Unidirectional rotation provides larger inlet ports which reduce any tendency toward cavitation.



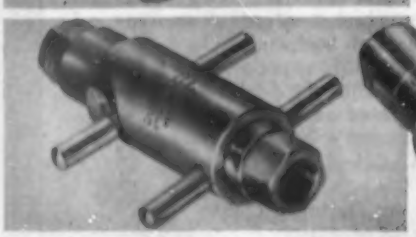
Features: The four pumps in the H series deliver 40-50-60-70 gpm at 1200 rpm and operate at pressures up to 1500 psi. Pressure balanced wear plates keep volumetric efficiency high at all pressures. Balanced hydraulic forces on both sides of the plates accurately maintain fixed clearances between the plates and the gear faces. Oil slippage is re-

for best performance—I recommend
DUKES New Hydraulic
BREAK AWAY
SELF-SEALING
COUPLERS

DUKES BREAK-AWAY COUPLER
Model 112 KS

Here's a break-away coupler that *does* couple with full pressure on both sides of the line.

- POSITIVE BREAK-AWAY ACTION
- POSITIVE SELF-SEALING
- NYLON VALVE SEATS
- SELF ALIGNING
- CAN BE MOUNTED *INDIVIDUALLY* OR IN *TANDEM*
- DESIGNED TO MEET EQUIPMENT MANUFACTURER'S REQUIREMENTS
- BUILT TO WITHSTAND HARD USAGE



Model H&C 100
IN LINE BREAK-AWAY COUPLER
No mounting brackets needed. Special *patented* compensating chamber allows recoupling by hand under full line pressure. Nylon valve seats assure positive sealing.

Model 303 KNURLED SLEEVE
Model 303-H HEX SLEEVE
DUKES IN LINE QUICK COUPLERS
For mounted equipment. Simplicity of design yet rugged construction assures satisfaction and ease of continuous operation. Nylon valve seats. Include all of above features except break-away action.

Manufacturers of Cylinders, Valves, Couplers and Fittings
"Member of the National Fluid Power Association"

DUKES COMPANY, Inc.
2108 N. Southport • Chicago 14, Illinois
Phone: Diversey 8-6326

Circle 218 on Reader Service Card

It's too hot in August to read a long story . . .

BUT HERE'S A MAJOR POINT TO REMEMBER:

In pneumatic circuits, the closer the valve to the cylinder, the faster, more efficient and more economical is the operation. The Bellows Air Motor offers the ultimate in "close coupling"—air cylinder and valve in one integral unit.

For the detailed story write for Bulletin CL-50

The Bellows Co.

670A

Continued

duced to a fixed minimum and frictional contacts are eliminated.

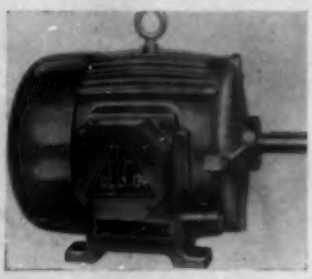
Application: The gear type pumps are designed for heavy duty use in machine tools, materials handling, earth moving and other mobile equipment.

Hydreco Division,
New York Air Brake Co.,
Cleveland 17, Ohio
Circle 212 on Reader Service Card

AC ELECTRIC MOTORS
. . . for hydraulic pump drives

Size: Frame sizes from 182 through 326

Construction: One of the newly designed squirrel cage motors is the open drip proof motor which features cast iron main and end frames, aluminum die cast rotors, grease lubricated double shielded ball bearings, exclusive cotton and varnish insulation and a drip proof baffle cast as part of the end frame which protects the motor from dripping liquids. Another of the newly designed electric motors



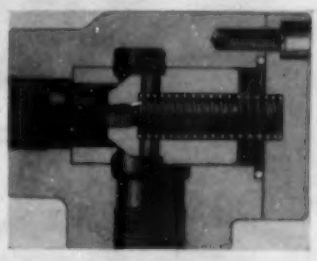
is the totally enclosed fan cooled motor. This motor is built with sturdy ribbed frame construction which allows the external fan to direct air effectively over the smooth ribbed frame. Cooler operating temperatures are obtained.

Delco Products,
Division of General Motors,
Dayton 1, Ohio
Circle 213 on Reader Service Card

HYDRAULIC CHECK VALVES
. . . permit large volume

Designation: Model 8640 is spring closed; Model 8642 is pilot operated and Model 8644 is pilot operated with pressure breaker.

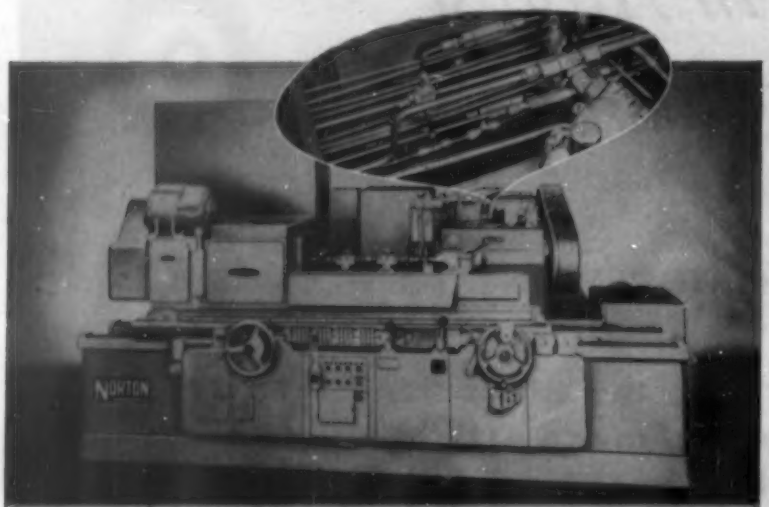
Size: Pipe thread or flange con-



nection, spring closed or pilot operated, in ¼ in to 1-½ in, mounting may be made in any position.

Features: The 3000 psi valve allows free flow in one direction and prevents flow in opposite direction. Large area which permits unusually large volume. The 1-½ in valve has a 104.2 gpm capacity at 15 ft per sec.

Rivett Lathe & Grinder, Inc.,
Boston, Mass.
Circle 214 on Reader Service Card



CAMSHAFT GRINDING—HIGH PRESSURE JOB
TAILOR MADE FOR SUPERIOR HYDRAULIC TUBING

One reason why Detroit can turn out cars in such huge numbers is their use of new machine tools which, until a few years ago, were just a gleam in a designer's eye. Good example is the Cam-O-Matic® . . . a high speed, fully automatic camshaft grinder developed by the Norton Company of Worcester, Mass.

The Cam-O-Matic has a highly complex hydraulic system for holding and positioning work, controlled by an electronic brain which times the sequences of operation. To make this tubing network as failure-free as possible, Norton engineers selected Superior carbon steel hydraulic tubing as a standard component. They knew from experience that Superior *higher-than-industry-quality* tubing can take (1) the punishment of vibration; (2) the high pressures put out by modern hydraulic circulating systems; (3) the severe flaring and bending necessary in assembly. As a result, machine down-time due to tubing failure has been eliminated.

If you use hydraulic tubing and your specifications demand exact analysis, unusual fabricating ease and dimensions that are precise—specify Superior. Mail this coupon today for Bulletin 38, Catalog Section 30 and the name of your nearest distributor.

*Trade Mark Reg. U.S. Pat. Off.

Superior
THE BIG NAME IN SMALL TUBING
All analyses .010" to ½" O.D.
Certain analyses (.035" max. wall) up to 1¼" O.D.

Superior Tube Company
2030 Germantown Ave., Norristown, Pa.

Please send Bulletin 38, Catalog Section 30 on Superior hydraulic tubing, and the name of my nearest Superior distributor.

Name_____
Company_____
Address_____
City_____ Zone____ State____

POSITIVE SEALING
. . . for encased oil seal

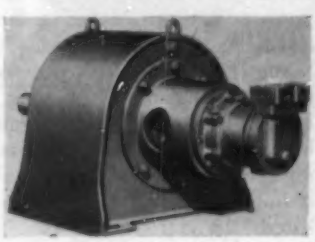
Designation: National Redicoat
Features: The process consists of a coating material on the metal circumference of the oil seal. The coating serves as the sealer, no cement is required. The coating material is hard to the touch, does not adhere to containers, other seals or pick up dirt and is brightly colored for ready identification. As the oil seal is introduced into a press-fit bore, the coating completely fills radial or circumferential scratches or imperfections as deep as .003 in. Once in place, the sealing is permanent and is unaffected by temperatures ranging from –60 F to 350 F. No special preparations are needed for installation,

even after prolonged operation and seals may be removed easily at high temperature.

National Motor Bearing Co., Inc., Redwood City, Cal.
Circle 215 on Reader Service Card

HYDRAULIC MOTORS
. . . integral with gear reducers

Designation: Oilgearducer
Design: Constant displacement, axial piston motors and Falk's complete line of concentric and right angle all steel reducers are combined into a new line. Oilgear motors, in sizes of 1, 3, 8, 12, and 20 hp are flanged and resilient coupling connected to Falk single, double, triple and quadruple reducers with ratio



combinations providing maximum output torques ranging from 42 lb-in to 41500 lb-in are

Electrol Hand Pumps for Uniform 2-Way Pumping Action

The Electrol 525 Hand Pump has a volumetric capacity of 1.5 cu. in. per cycle.

The Electrol 770 Hand Pump has a volumetric capacity of of 2 cu. in. per cycle.

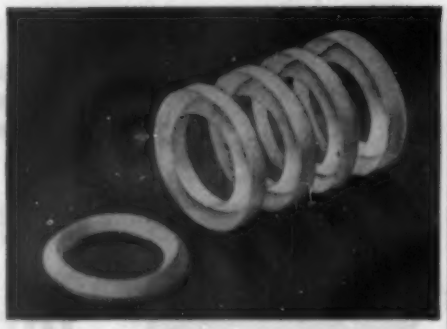
Electrol Double-Acting Hand Pumps are capable of delivering uniform volume, with operating pressures up to 1,500 P.S.I. They are compact in design . . . have few moving parts . . . are low in cost . . . economical in operation. They have built-in suction and pressure check valves . . . ⅜" pipe thread ports . . . and can be used in mineral oil or water. Also, there are similar units available for use in gasoline, kerosene, or equivalent aromatic fluids. Complete engineering data can be obtained on request.

Electrol
HYDRAULICS
KINGSTON, NEW YORK
Telephone, Kingston 1980

CYLINDERS • SELECTOR VALVES • FOLLOW-UP VALVES • CHECK VALVES • RELIEF VALVES • HAND PUMPS • POWERPACKS • LANDING GEAR GLEARS • SOLENOID VALVES • ON-OFF VALVES • SERVO CYLINDERS • TRANSFER VALVES • CUT-OUT VALVES • SPEED CONTROL VALVES

Better Designed Products Use Electrol Hydraulics

Circle 31 on Reader Service Card



the V-Ring Packing

no hydraulic fluid can attack

Chemiseal V-Ring Packing is made of pure duPont TEFLON to outlast other packing materials many times over. Ideal for manual or automatically operated valves.

Distinctive tapered V-design offers greater flexibility and resiliency—providing the necessary seal at low gland pressure and reducing torque required to operate valve.

An extremely anti-hesive, anti-friction, non-absorbent, chemically inert, non-flammable material for service temperatures from —110°F to plus 500°F. Offered in sets with square-end TEFLON adaptors. Ask for Bulletin No. TP-1053.

Other U.S.G. Engineered Packings...

include Chemiseal synthetic rubber "O"-Rings —and Chem-o-green Spiral back-up Rings—companion products sold as a "Packing Package" for all commercial and AN requirements. Ask for Catalog OB-1152.

UNITED STATES GASKET COMPANY

CAMDEN 1 • NEW JERSEY

FABRICATORS OF duPont TEFLON, Kellogg KEL-F AND OTHER PLASTICS

Representatives in Principal Cities Throughout the World

New Products

Continued

based on a pressure of 1100 psi. When used in combination with variable delivery pumps (input units), they provide accurate regulation over entire range, an infinite speed range (stepless), cushioned and controlled acceleration and deceleration, quick reversal, constant torque over entire range, hydrodynamic braking, continuous service on reversing, starting, stopping and frequent speed change applications, safe operation in hazardous locations, and automatic protection against overload.

Applications: Used on drives where accuracies from .1 to .5 percent are essential or advantageous over a wide range of loads and speed ratios or where a number of sections of a machine are to be synchronized at different speed ratios.

The Oilgear Company, Milwaukee 4, Wis.

Circle 216 on Reader Service Card

PLUG TYPE VALVE
. . . for pressures up to 300 psi

Designation: 200 series

Size: Male to female, and male

to male pipe thread—in 3 different pipe thread sizes—⅛ in, ¼ in and ⅜ in. Valve is directional and inlet is marked.

Design: Floating stem promotes perfect alignment of plug in body. The stem is sealed against leakage by an "O" ring. Retaining shoulder on the stem makes it impossible for the stem to be lifted.

Features: Pressure balanced plug and is recommended for working pressures to 300 psi.

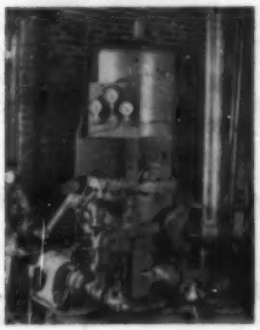
Circle 91 on Reader Service Card

Convenient brackets are provided on valve for mounting on instrument panels.

The Imperial Brass Mfg. Co., Chicago 7, Illinois
Circle 217 on Reader Service Card

WATER AND COOLANT FILTERS
. . . are hydraulically balanced

Designation: Flo-Klean
Design: The new design is a top feed, balanced backwash nozzle

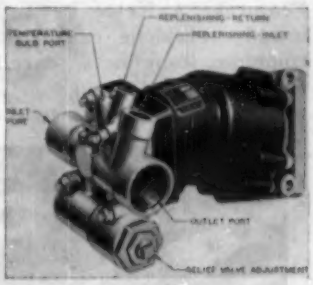


which has had an accumulated field operating experience of about two years. Nozzle design with hydraulically balanced discharge reduces bearing and motor loads.
Specifications: Capacity up to 1275 gpm and a range of degree of filtration from .0025 in to .030 in (230 to 25 mesh). Other designs are available with capacities to 15,000 gpm.
Applications: Used by plants to permit direct intake of raw water from such sources as lakes, rivers and wells. It is also used widely for the recovery and reuse of coolants on hot and cold metal rolling mills and centralized machine tool coolant systems.

Cuno Engineering Corp. Meriden, Conn.
Circle 218 on Reader Service Card

HYDRAULIC MOTOR
. . . with manifold head

Designation: MS70-3915
Design: Range in capacity from .442 gpm (at 1500 rpm) to 23.8 gpm (at 1500 rpm). The smallest size may be operated at speeds up to 9100 rpm. The larger sizes must be operated at slower speeds.
Features: A special head, or valve plate, is provided which includes an integral relief valve, a temperature bulb port, and two special ports for a circuit re-



plenishing requirement. These features are in addition to the standard inlet and outlet ports. The new design results in the elimination of eight connections and two lengths of hose in the hydraulic circuit.

Vickers, Inc., Detroit 32, Mich.
Circle 219 on Reader Service Card

KELON-T TAPE
. . . for non-sticky surfaces

Size: Available in widths up to

Air and Hydraulic Cylinders

• FOR HEAVY-DUTY APPLICATIONS OF ALL TYPES • TO MEET ALL SIZE AND PRESSURE REQUIREMENTS • BORES TO 60" DIAMETER • STROKES OF 50 FT. AND LONGER

Lincoln Machine Company will design, engineer and build standard or special hydraulic and pneumatic cylinders with trunion, rod-end flange, blank-end flange, foot, clevis or centerline mountings.

Call on Lincoln when you require large, powerful rotating or non-rotating hydraulic and air cylinders, heavy-duty mill-type cylinders. Our engineering department will give you fast, practical assistance in design problems . . . and our modern plant will build your cylinders quickly and economically.

18½" Bore
13" Rod
3000 PSI

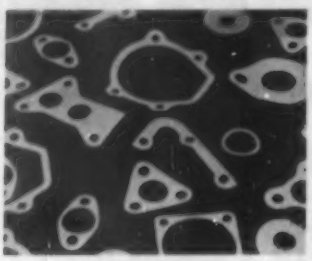
Write today for Lincoln's catalog. It gives engineering data on many types and sizes of heavy-duty cylinders.

LINCOLN MACHINE CO., INC.
326 West 2nd Street—Salem, Ohio

Continued

12 in, with thicknesses varying from .002 to .125 in.

Features: A Kelon-T (Teflon-tetrafluorethylene resin) tape combines toughness, excellent electric properties and resistance to abrasion and corrosion chem-



icals at high and low temperatures. The tape elongates to fit tightly over sharp bends and corners to make a firm secure covering.

Applications: The non-adhesive, chemically inert tape has a wide range of applications in electrical, hydraulic, aircraft and food industries. Useful in motors and generators and in high temperature resistant capacitors.

W. S. Shamban & Co., Culver City, Cal.
Circle 220 on Reader Service Card

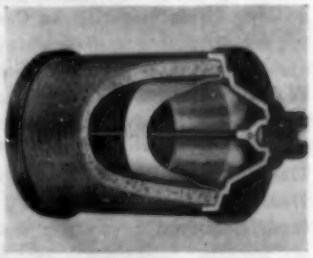
EXHAUST MUFFLER
. . . checks noise of air devices

Designation: HC Model

Size: Range from ⅛ to 2 in, standard pipe size

Design: Employs an aluminum deflector shield resigned to form an acoustic chamber to minimize direct contact of the dissemintor by the high velocity air stream, without sacrificing radiation surface. This shield also acts as a condenser to precipitate moisture present in the air system holding vapor spray to a minimum.

Applications: Design characteristics do not restrict full volume air flow maintaining absolute minimum back pressure. Used for optimum silencing of air devices operating at high air pressures, where the air has high moisture content, on rapid cycling equipment and where air



borne dust particles are present in the air system. Affixed directly to the exhaust aperture and will operate satisfactorily in any position.

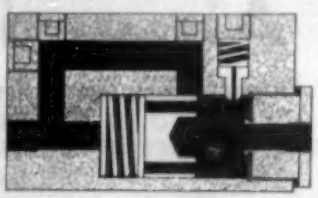
Allied Witan Company, Cleveland 11, Ohio
Circle 221 on Reader Service Card

CUSHIONING DEVICE
. . . for air and oil circuits

Designation: Hydro-Chek

Size: Two sizes; 6 in long and 2-¼ in sq, 6 in long and 2½ in sq

Features: Positive control and cushioning of shock without restriction of pressure. This valve



can readily be adapted to many types of air or hydraulically operated equipment. Extensive work has been performed on air and hydraulically operated shovels, precision machines. There is less wear on all moving parts.

Specifications: Working pressures 4000 psi on 2-¼ and 8000 psi on 2-½ in.

Hydro-Chek Sales Company, Canton, Ohio
Circle 222 on Reader Service Card

PNEUMATIC POWER FEED
. . . for drill presses

Designation: Rotafeed

Sizes: Model 343 feeds drills up to ¾ in while model 465 feeds drills up to 1-¼ in.

POWER STEERING

Without A Special Pump

For loaders, lift trucks, tractors and ditchers which have a hydraulic system for other functions.

Regulated flow has preference—bypass flow can be used for other hydraulic operations.

- Considerable savings over separate pump
- Available ¼" thru 1" pipe sizes

Write or phone Mentor, Ohio, BLackburn 5-2626 for complete specifications.

Fluid Controls, inc.

Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves • Needle Valves • Pilot Check Valves • Clamping Valves • Small Spring Loaded Accumulators • Special Valves

1284 NORTH CENTER STREET • MENTOR, OHIO

Features: Attaches directly to the drill press spindle and operates on 40-60 psi on the power stroke and 10-15 psi on the return stroke. These low pressures provide extra capacity for multiple spindle drilling or tapping. Instantaneous rapid approach and infinitely variable hydraulic

feed control with rapid return is provided.

The Pneuma-Draulic Co., Detroit 6, Mich.
Circle 223 on Reader Service Card

AIR CYLINDER
. . . has adjustable mounting

Construction: Well adapted where air operated ejectors are required, such as in metal stamping, die casting and plastic molding. Made of heavy wall brass tubing. The 5/16 in dia shaft has rapid spring return,

mounting bracket is 3/16 in steel. The entire assembly has smooth finish and is nickel plated. Standard cylinder has a 1 in bore and 2-½ in stroke. The mounting bracket provides a 3 in longitudinal, 360 degree radial adjustment. Cartridge type cylinder easily replaced without removing the bracket from the mounted position.

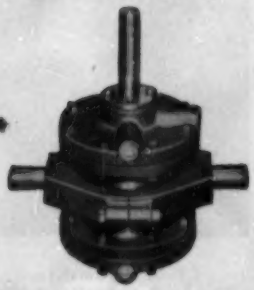
Summit Tool & Mfg. Co., Toledo 11, Ohio
Circle 224 on Reader Service Card

Air or hydraulic...

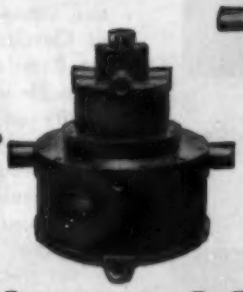
big...
24" BORE

little...
2" BORE

standard...



special...
COMPOUND CYLINDER
12" BORE + 6" BORE



...Anker-Holth matches your cylinder needs exactly

• When you bring your power cylinder problems to Anker-Holth, you get the engineering assistance of cylinder specialists . . . backed by our modern manufacturing facilities. There is no compromise. If it takes a special cylinder—regardless of size or type—you get the *right* power cylinder for your specific requirements . . . air or hydraulic.

Call or write for this help today. Anker-Holth Division of The Wellman Engineering Company, Dept. C-14, 2723 Conner St., Port Huron, Michigan.

FREE on request... bulletin on complete line of Anker-Holth products.

Anker-Holth
ENGINEERED CYLINDER POWER
WELLMAN
Division of THE WELLMAN ENGINEERING COMPANY

Post Scripts of Industry

News about people, manufacturers and sales organizations

T. J. McCuistion
The Parker Appliance Co.

Kenneth C. Strait
The Parker Appliance Co.

Richard O. Jessup
Warner Division,
Detroit Harvester Co.

Tommy J. McCuistion has been named sales manager of the rubber products division of **The Parker Appliance Company. Frank A. Depatie,** former rubber division sales manager will move to Detroit to direct rubber sales in Michigan, giving special emphasis to the automotive industry. McCuistion comes to Parker after six years as Cleveland branch manager for the Precision Rubber Products Corp. He is widely known as an authority on "O" ring applications. Depatie joined the company in 1948, becoming manager of sales for the rubber products division in 1952. Also announced was the appointment of **Kenneth C. Strait** to the position of sales engineer in the Cincinnati and lower Ohio territory, succeeding Gordon Miscall who recently resigned. Prior to assuming his new duties in the field, Strait attended an intensive training course at the Cleveland plant, receiving detailed instruction on the company line of hydraulic and fluid system components. Strait will make his home in Cincinnati and will work under the direction of E. W. Hollis, manager in the Cleveland district.

Appointment of **Richard O. Jessup** as west coast sales representative of the Warner Division of **Detroit Harvester Company,** has been announced. The establishment of a new west coast sales office at Los Angeles to cover the states of Washington, Oregon, California and Arizona, is part of a sales expansion program.

Appointment of two new branch managers and the creation of a new district managership at Greensboro, N. C., is announced by **Minneapolis-Honeywell Regulator Company. Merritt Eusey,** former head of the company's Baltimore branch has been named to head the Pittsburgh office, succeeding Ray Weikel who has assumed a supervisory position with the industrial division in Philadelphia. **Robert S. Warnick,** formerly a supervisory commercial salesman in the Philadelphia office, has succeeded Eusey as branch manager in Baltimore. **Donald H. Hannasch** has been appointed to the newly created position of district manager at Greensboro. The office formerly was under the direct supervision of the Charlotte office. Hannasch has been resident salesman at Rochester, Minn.

The Fielden Instrument Division of **Robertshaw-Fulton Controls Company,** has appointed **Donald Daily** and **William H. Johnson** to the sales staff. Both Daily and Johnson have been engaged in engineering work in the instruments field since 1950.

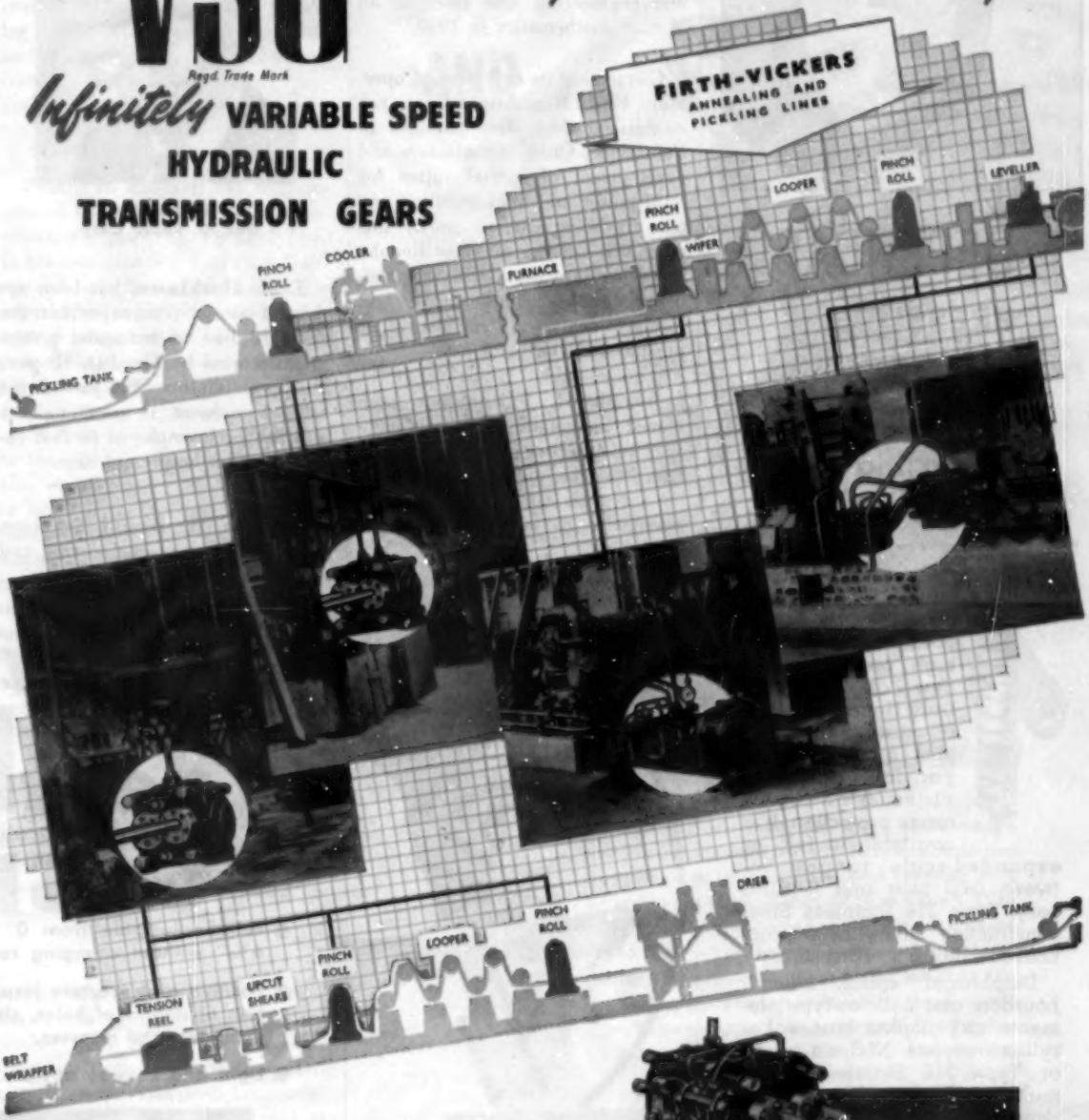
Servomechanisms, Inc. has named **John R. Crawford** to the position of sales manager of its components division in Westbury, N. Y. In his new post Crawford will be responsible for the components division's overall efforts and customer service program.

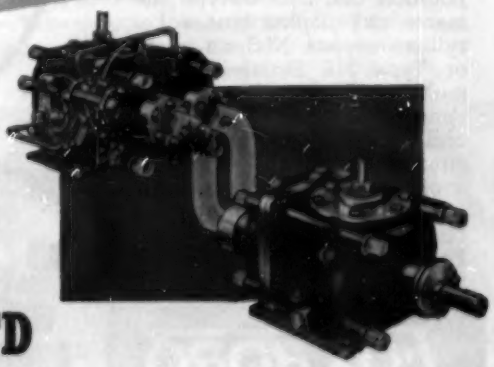
Leo A. Schmidt, specialist in fluid dynamics, has been named supervisor of the aerodynamics and compressible flow section in the propulsion and structural research department at Armour Research Foundation of **Illinois Institute of Technology,** Chicago. Schmidt was promoted from assistant supervisor of the section. He joined the foundation in 1949 as a graduate fel-

'VSG' *Serving Modern Industry*

Regd. Trade Mark

Infinitely VARIABLE SPEED HYDRAULIC TRANSMISSION GEARS





Extensive new plant has recently been installed in Sheffield, England, by Firth Vickers and Samuel Fox. The above illustrations show one of the Pickling and Annealing Lines. For precise speed control over a wide range and for accurate synchronisation of each section drive 'VSG' Hydraulic Transmission Gears were selected.

VICKERS-ARMSTRONGS LTD

VICKERS HOUSE BROADWAY LONDON SWI ENGLAND Cables VICASTRONG LONDON

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DEPENDABLE
PRESSURE
RECORDING
...even in
cycling
service

Pressures which vary widely and rapidly can now be measured with sustained high precision. The new Foxboro Heavy Duty Helical Element (illustrated) also permits high scale expansion, and provides high over-range protection. It is available in full- or expanded-scale ranges between 0-50 psig and 0-80,000 psig. Type 316 Stainless Steel construction gives best practical resistance to corrosion.

Diaphragm, spiral, helical, bourdon, and bellows-type elements, of phosphor bronze, beryllium copper, Ni-Span alloy, or Type 316 Stainless Steel, make the Foxboro line of Indicating, Recording, Controlling, and Transmitting Pressure Instruments the most complete available. Round or rectangular cases. For specific information on your problem, write The Foxboro Company, 218 Norfolk Street, Foxboro, Mass., U.S.A.

FOXBORO

Post Scripts of Industry

low and was promoted to assistant supervisor in 1952. Schmidt was graduated from Illinois Tech in 1947 with a B.S. degree in mechanical engineering and received an M.S. in mathematics in 1949.

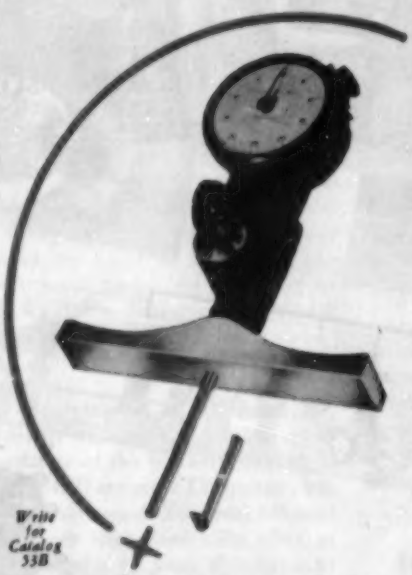
Completing its first year of operation, **Fluid Regulators Corp.** has established their shop facilities in Painesville, Ohio. Manufacture and development of special valves for fluid power and fluid handling systems is being carried on by this company. Officers of Fluid Regulators Corp. are Donald Stark, president; Frank Schindler, executive vice president; and Paul Lisby, vice president in charge of production.

Joseph H. Fallon has been named Cincinnati district sales manager for **Sterling Electric Motors, Inc.** Prior to joining Sterling, Fallon served as a manufacturer's representative in southern Ohio and Kentucky.

J. M. Hoskinson
Geo. D. Roper Corp.

J. M. Hoskinson has been appointed as sales manager for the standard line of industrial pumps manufactured by **Geo. D. Roper, Pump Division.** He joined the sales department as sales engineer and has been employed in that capacity up to the present time.

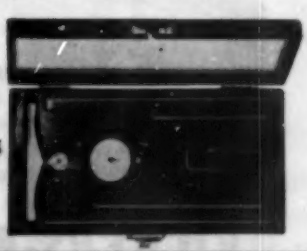
Warren H. Brand has been named director of engineering and



Write for Catalog 53B

Reliant
ADJUSTABLE
depth
and groove location
GAGE

- Fully adjustable from 0" to 6¾" without changing rods.
- Positive and accurate inspection of depths of holes, slots, shoulders and recesses.
- Light and easy to operate.



Reliant Industries
4947 Firestone Boulevard
SOUTHGATE, CALIFORNIA

ALSO MANUFACTURERS OF PRECISION GAGES FOR CHECKING GROOVE DIMENSIONS FOR "O" RINGS AND SNAP RINGS

research by **Conoflow Corp.** Brand is well known in engineering circles particularly in the fields of instrumentation and automatic control. Before joining the company, he served with the atomic energy commission. Brand's new duties will include the supervision of the administrative functions of the engineering department and the integration and expansion of present and future research and development programs.

Philip H. Emrich has been appointed manager of the Joplin manufacturing plant of **Vickers Inc.** In his new capacity, Emrich will direct all activities of the plant. He joined the company's Detroit headquarters organization in 1936. **Gordon Elliott,** who has supervised plant construction and initial production at the Joplin plant, returns to his former capacity as manager of the plant in Omaha. Appointed also was **Gregory M. McKeown,** as head of the product service department. In his new capacity, McKeown succeeds Emrich and will be in charge of replacement parts, publications, training, product improvement and field service. He joined Vickers in 1936 as Navy test engineer. **George C. Bonnell** has been named assistant head of the product service department.

The board of directors of **Commercial Filters Corporation,** Melrose, Mass., announces the election of **Robert L. Fielding** as president and treasurer.

The Watts Company of Houston, Texas has been appointed exclusive sales representative for Conoflow Corporation in southeastern Texas and southwest Louisiana. The Watts Company is located at 4101 San Jacinto Street, Houston 4, Texas.

Appointment of **Peter G. Sloan,** 12734 Woodland Ave, Cleveland, as Ohio sales representative for **Goshen Rubber Co. Inc.,** has been made. Sloan has had wide experience in the field of manufactured

UNDEFEATED!
AND
STILL
CHAMPION
CAN YOU SUPPLY A CHALLENGER?
. . . That difficult fluid, gas, or air transmission problem in your plant—We'll send you a Snap-tite Hi-Flow quick connect disconnect coupling with or without automatic shut-off in any size 1/8" to 3"—Test it in your plant, under actual working conditions—You be the judge—If it doesn't solve your problem or do a better job than the coupling you are now using, ship it back collect—Write today on your letterhead, briefly outlining your problem—We'll ship immediately.
Snap-tite
INC.
201 S. Rockwood, Union City, Penna.

Circle 79 on Reader Service Card

rubber parts for industry. Goshen Rubber produces "O" rings as well as molded, die-cut and lathe-cut rubber parts from natural, synthetic and silicone compounds.

At a recent board meeting of the **Acushnet Process Company, Richard B. Young** was elected treasurer, a position formerly held by his father, Phillip E. Young, who continues as president. **Karl P. Goodwin,** 2nd vice president and director of sales of the rubber division was elected to membership on the board of directors. Young started as a trainee, served a full apprenticeship in practically all departments. Goodwin started in the engineering department of the rubber division.

An authorized **Hoke, Inc.** distributor has been appointed. **Crawford Fitting Co.,** 884 East 140th Street, Cleveland 10, Ohio, is ready to serve in supplying their valves, regulators, flo-gages or cylinders from stock or in making engineering information available, concerning any phase of their products.

Harry Kirby
Marsh Instrument Co.

Harry Kirby has been named by **Marsh Instrument Company** to head their Cleveland office. Kirby will represent Marsh and will direct his sales efforts toward the manufacturers of original equipment. Territory to be covered by him will include portions of Pennsylvania and New York in addition to all of northern Ohio.

Lane Engineering Company has appointed **Laurence G. Roberts** as sales engineer. Roberts has been connected with the Ford Motor Company for the past several years in various positions. He comes to Lane with a broad background of sales, service and engineering experience. He is being assigned to the western New York territory and will make his headquarters in Buffalo.

Wilbur J. Wright, for the past twenty years, associated with Horace G. Preston Company, is now representing the **Page Belting Co.** of Concord, N.H., in the sale of hydraulic and pneumatic leather packings, in Ohio and surrounding areas. He is operating from 17821 Clifton Blvd., Lakewood 7, Ohio. Wright is known throughout the industrial middle west as an authority on leather packings.

REMOTE Cylinder CONTROL

with Ledeen POWER operated VALVES

Hand Valves

Foot Valves

Instant action of remotely located or automatically operated cylinders is made possible with the new and improved Ledeen Power Operated Valves. These disc-type valves are positive in operation, and are readily adaptable to a wide variety of pilot controls. Solenoid operated power valves are available as complete package units.

Ledeen Power Operated Valves are fast cycling, have few moving parts, and require very little maintenance. They are available from stock for quick delivery.

Write for Bulletin 1010.

VALVES • CYLINDERS
VALVE ACTUATORS
AIR HYDRAULIC
PUMPS & BOOSTERS

Ledeen Mfg. Co.
1610 So. San Pedro St.
Los Angeles 15, Cal.

revolutionary

NEW PROCESS PRODUCES SUPERIOR QUALITY "O" RINGS AT COMPETITIVE PRICES

LINEAR ROTO-MOLDED "O" RINGS

Now, for the first time, you can use precision-made *compression-molded* "O" Rings, with all their inherent superiority, *at prices as low as injection molded "O" Rings!*

Exclusive with LINEAR, a new, high-speed process produces ROTO-MOLDED perfect circle "O" Rings with precise tolerances, extreme uniformity, flash-free finish and pre-stretched grain structure, at a lower cost than ever before possible.

This will be good news for your customers: low cost selling with greater resistance to heat, greater resistance to distortion under pressure, greater tensile strength and wearing qualities.

You can get these new LINEAR ROTO-MOLDED perfect circle "O" Rings in a variety of standard sizes and materials, including special types and sizes for specific applications.
For full information and prices, write or call LINEAR today.

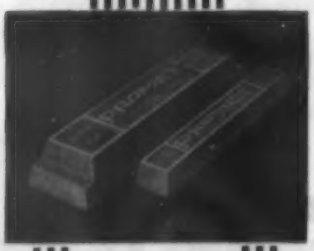
"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.

Circle 56 on Reader Service Card

Why PROMET BABBITT Excels All Others–



A soft metal with unequalled lubricating properties, yet with so close a structure that it is more resistant to compression and wear than harder metals.

In the most severe industrial service, Promet babbitt has never failed to provide complete satisfaction in comparison with any material previously used.

High compressive strength—Promet babbitt metal has greater compressive strength than that of any other white metal, except those which contain an excess of copper and/or nickel and which are, therefore, not too suitable for bearing purposes because of the danger of cutting or scoring the shaft.

Low coefficient of friction.

Strength at elevated temperatures which would almost be considered dangerous with ordinary babbitt metals.

Chemical permanence—Promet babbitt will not disintegrate or lose any of its properties by the action of moisture, heat, extreme service, repeated remelting, or any chemicals used in ordinary manufacturing processes. Constant repouring has only a refining action. It is only necessary to heat Promet metal from 900 degrees to 950 degrees F. and pour. Promet will not "burn" or spoil and can be heated to 2000 degrees F. without injury. There is practically no dross.

Temporary failure of lubrication—Promet babbitt metals, because of their natural lubricating properties, cannot cut or score the shaft under *any* circumstances.

Minimum shrinkage—Trouble arising from imperfect contact of Promet babbitt metals with their supporting shells is practically nil.

If you wish to examine a sample of Promet, a miniature pig of the metal will be sent for your test upon request.

The
AMERICAN CRUCIBLE PRODUCTS CO.
1303 Oberlin Ave.
Lorain, Ohio, U.S.A.

Post Scripts of Industry

Oilgear Honors Old Timers

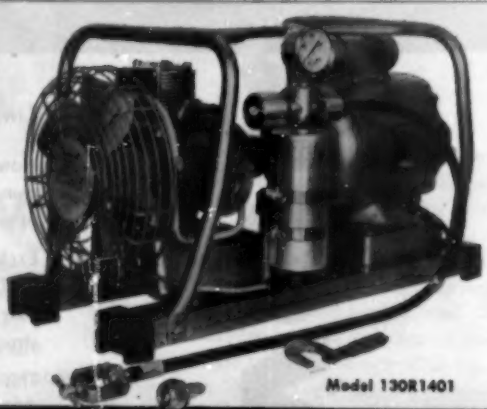
The Oilgear Company, pioneer hydraulic component manufacturer, Milwaukee, Wis., held their annual Old Timers' Banquet on May 18th. Special honor was paid to twelve officers and employees now members of the Oilgear 30 Year Club. Walter Ferris, a founder member and now vice president and consulting engineer, has been active through the entire history of the company. The Old Timers' Banquet is held annually for all those who have been members of the Oilgear organization for ten years or more. This year nine ten-year service officers and employees were honored.

An unusual record has been achieved by this organization in that 55 percent of all employees have been with the company for ten years or more and 25 percent have completed 25 years or more with the company.

Seated, left to right: L. M. Gross; Walter Ferris; Miss M. J. Haendel; H. L. Crull, assistant sales manager; V. Anderson; standing: K. F. Kattner, assistant purchasing agent; G. Heiden; J. O'Rourke, chief inspector; A. Degner; R. D. Packenham, secretary-treasurer; J. Sabec; and A. Hoffman, shop superintendent.

NEW

3000 PSI AIR COMPRESSOR AVAILABLE TO HYDRAULIC DESIGN ENGINEERS



Model 130R1401

FOR PRESSURIZING HYDRAULIC ACCUMULATORS AND AIR RECEIVERS

Reduce accumulator size through use of higher pressure. Service accumulators individually on remotely located machines or those requiring special pressures. Maintain pressure in central system accumulators automatically. Cornelius High Pressure Air Compressor, Model 130R1401, is entirely portable and instantly available for use at any point in your plant where replacement air to 3000 PSI is required. This portable 3 stage air cooled air compressor provides clean air at pressures to 3000 PSI — capacity 2 SCFM. Model illustrated above including 1 H. P. heavy-duty A.C. electric motor weighs only 79 pounds.

Cornelius
PORTABLE
AIR COMPRESSORS

WRITE FOR PRODUCT SHEET NO. 5
We invite your inquiry and shall be pleased to send you complete details.

THE CORNELIUS COMPANY
560 39th Ave., N.E. • Minneapolis 21, Minnesota

Graham B. Brown has been appointed works manager of the **Tube Reducing Corp.** Before joining the company in 1951. Brown was employed during the period 1948-1951 as iron and steel advisor to the munitions board, and chief of the office of the material requirements board. The duties of his new position will include supervision of the plant's production, engineering, maintenance and new product development departments.

H. K. Porter Company, Inc. Pittsburgh, announces acquisition of **Pioneer Rubber Mills Inc.** manufacturer of industrial rubber products on the Pacific coast. The plant will become part of the Quaker Rubber Corp., one of H. K. Porter Company's nine divisions. Pioneer Rubber Mills will retain its identity. **Sumner M. Suhr,** sales manager has been appointed manager of the new division under George A. Dauphinais, vice president and general manager of Quaker Rubber Corp.

As part of a modernization and facilities improvement, **Worthington Corp.,** is announcing a new location for its Twin Cities district office, at 807 Thirteenth Ave., South, Minneapolis.

John F. Jorgensen
Webster Electric Co.

Management of the **Webster Electric Company,** has announced the appointment of **John F. Jorgensen** to the position of assistant sales manager of the oil hydraulics division. Previous to this appointment, Jorgensen had been a sales representative of the division. His previous position has been filled by **A. J. Casser.**

To Better Serve You

Warner Doubles Plant Facilities
Steps-up Precision Subcontracting Work

THE Warner Division of Detroit Harvester Company has moved into a new and larger manufacturing plant.

In addition to permitting an increase in the production of hydraulic units of their own design, such as pumps, valves and actuators, this expansion places Warner in a position to take on additional precision subcontracting work for aircraft and ordnance plants.

Capitalize on Warner's ability to manufacture to exacting tolerances.

Consider Warner for the production of—
Landing Gear Cylinders, Pumps, and Valves
Hydraulic and Pneumatic Assemblies
Aircraft Fittings
Machining of Aircraft Forgings

Contact our home office in Detroit or the branch office nearest to you. Warner engineers will welcome the opportunity to serve you.

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520 West Avenue, Room 212
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Phone: Volunteer 6-1534

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Dayton 9, Ohio
Phone: Walnut 4247

JESSUP ENGINEERING CO.
7227 W. 90th St.
Los Angeles 45, California
Phone: Orchard 2-1616

M. E. DOUGLAS
2242 Forest Park Blvd.
Fort Worth 10, Texas
Phone: Wilson 0555

Warner DIVISION OF DETROIT HARVESTER COMPANY
14300 FIREMAN AVENUE • DETROIT 28, MICHIGAN
DESIGNERS AND MANUFACTURERS OF HYDRAULIC PUMPS • VALVES • ACTUATORS

special tanning means special advantages

Tannate is the tradename for the special tanned leather developed and produced by J. E. Rhoads and Sons especially for the manufacture of mechanical leather packings. Tannate packings combine all these special advantages:

1. The extra strength of Tannate Leather enables these packings to withstand the highest pressures with a minimum of cold flow or extrusion.

2. Special tanning gives Tannate Packings a low coefficient of friction which means longer life because little heat is generated.

3. Rhoads Laboratory has developed a variety of impregnants which permits packings to operate from a few ounces pressure to many thousands of pounds psi. Tannate packings can be made flexible or rock hard to meet your requirements.

4. Tannate special tanned leather is molded with a minimum of strain because it is a flexible leather. This permits precision molding which insures a leak-proof seal.

5. Tannate Packings are job-engineered from start to finish, providing an effective seal against glycerin, alcohol, mineral, fish and animal oils, also water, vegetable or any other non-caustic, non-acid fluids.

If you have a special need for a packing that will seal better and last longer, specify Tannate Leather Packings.

Sales representatives in Principal Industrial Areas.

RHOADS
INDUSTRIAL LEATHERS

PHILADELPHIA • NEW YORK • CHICAGO • ATLANTA

Post Scripts of Industry

Standard Pressed Steel Co., has advanced three younger men to important positions. **William M. Briner** moves up from supervisor of industrial relations service to supervisor of industrial relations. **William M. Kerrigan,** formerly supervisor of planning and scheduling, has been made supervisor of production control, expediting and stock moving planning. **William J. Park** advanced from general foreman of quality control to manager of quality control.

The Rucker Company, western distributors of pneumatic and fluid power systems, has been appointed exclusive distributors for Powermatic hydraulic pumps and rams. According to Clark E. Rucker, president of the firm, the distributorship will cover the six western states and the territories of Alaska and Hawaii.

The Briggs Filtration Company announces the promotion of **Willard Eichelberger,** formerly a field engineer for the company, to manager of the engineering department. Eichelberger was formerly associated with American Oil Co. as a field engineer.

Promotion of **James W. Hendry,** widely known designer of plastics molding presses, to vice president of Jackson and Church Company, has been announced by president Clifford W. Stuart. Hendry developed the "pre-plasticizing process", which combines the advantages of injection, extrusion and transfer molding methods into one machine.

The Watson-Stillman Company Division of H. K. Porter Company, Inc., has established sales, service and manufacturing facilities in Holland through

a wholly owned subsidiary. The new foreign company, **Watson-Stillman Internationale Maatschappij, N. V.** is located in Rotterdam. Manufacturing facilities have been established with N. V. Machinefabriek "Breda", formerly Backer en Rueb, of Breda, Netherlands. "Breda" will manufacture a complete line of hydraulic machinery. The European offices will be located in the Groothandelsgebouwen Building in Rotterdam.

The Joe E. Parker Co., of Atlanta, Georgia, sales representatives and southern district headquarters for Bush Manufacturing Co. and its subsidiary **Heat-X-Changer Co.** has announced the appointment of **Donald R. Macklem** as a sales engineer. He will cover Alabama, Mississippi, central and western Tennessee and northern Florida.

Phelps Packing & Rubber Co., Inc., of Baltimore, Maryland, has been signed as a distributor of Parker O-Rings according to an announcement from **The Parker Appliance Company of Cleveland.** This distributor will have access to the technical assistance and customer application service of R. B. Jewett who is Parker manager in the Philadelphia district. Also announced was the appointment of **Industrial Piping Supply Company** of Charlotte, North Carolina, as distributor for Parker Products.

Board members of the Resistoflex Corp., Belleville, N. J. have elected **Joseph F. Gentile,** treasurer, and **Irving D. Press,** chief engineer, as vice presidents, Edgar S. Peierls, president announced recently. Gentile will continue as treasurer with partial responsibility also for manufacturing operations. He started with the company in 1940 as an accountant and became treasurer several years ago. Press, who will be vice president-engineering started with the company in 1946 as an engineer and became chief engineer three years ago.

an old principle
—an extraordinary result

ball bearings rolling on a FLAT surface

- *offer less friction*
- *are easy turning*
- *wear longer*

EMSCO
BALL BEARING SWIVEL FITTINGS

It's an old principle, a ball rolling on a flat surface – making a single point of contact, and when applied to a ball bearing swivel fitting you get an extraordinary result – free and easy rotation even under extreme pressures. Compare EMSCO on this point!

Should you take the EMSCO fitting apart – and it's easy to do because it breaks like a union, you'll note a unique packing and ball race design which permits easy adjustment for wear. No expensive return of fittings to the factory for service. Note also how the large fluid passageways and smooth, easy contour of bends reduces turbulence and increases flow.

You'll find an EMSCO ball bearing swivel fitting for almost any application.

GET THE COMPLETE ENGINEERING STORY FROM OUR NEW CATALOG TODAY.

8 BASIC STYLES — OVER 500 MODELS

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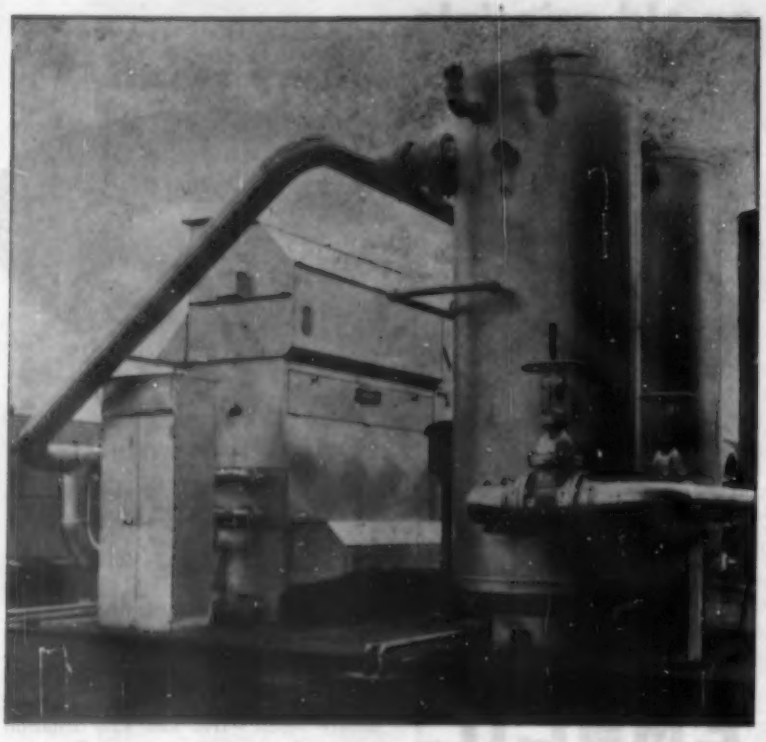
Representatives in principal cities

Circle 32 on Reader Service Card



HOW YOU SAVE,
Getting Drier Compressed Air

● Direct saving in the cost of cooling water saves the price of the Niagara Aero After Cooler (for compressed air or gas) in less than two years.

Extra, for no cost, the drier air gives you a better operation and lower costs in the use of all air-operated tools and machines, paint spraying, sand blasting or moisture-free air cleaning. Water saving also means less expense for piping, pumping, water treatment and water disposal, or you get the use of water elsewhere in your plant where it may be badly needed.

Niagara Aero After Cooler assures all these benefits because it cools compressed air or gas below the temperature of the surrounding atmosphere; there can be no further condensation in your air lines. It condenses the moisture by passing the air thru a coil on the surface of which water is evaporated, transferring the heat to the atmosphere. It is installed outdoors, protected from freezing in winter by the Niagara Balanced Wet Bulb Control.

Write for complete information; ask for Bulletin No. 98

NIAGARA BLOWER COMPANY

Dept. AH, 405 Lexington Ave. New York 17, N. Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

Post Scripts of Industry

Election of **Harold C. Stuart,** to the presidency of **The Aircraft Service Association** was announced by Thomas Wolfe, chairman of the board of governors of TASA. The Aircraft Service Association, Inc. held its first annual meeting in Washington, D. C. and established a permanent headquarters and office for TASA at 1001 Connecticut Ave., Washington 6, D.C., to coordinate activities of the association. Wolfe served as president during its first eighteen months of organization.

American Engineering Company of Philadelphia, Pa., has appointed **Sintes Sales Engineers,** New Orleans, La., as their hydraulic representative for the entire states of Louisiana and Mississippi and the gulf counties of Texas.

Greer Dedicates New Plant

On June 10, the new plant and office of Greer Hydraulics, Inc., at New York International Airport, Jamiaca, New York, was dedicated in a ceremony that attracted over 400 leaders in the field of aviation, industry, government and the armed services. Howard S. Cullman, chairman, The Port of New York Authority, presided and turned over the first industrial building to be erected on the airport to Edward M. Greer, president and chief engineer, and Robert P. Lord, secretary-treasurer and general manager.

The new plant was designed and constructed by the Port of New York Authority to meet Greer specifications and has been leased to Greer on a long term basis. The company took possession of the one and one-half million dollar plant on July 1st. The building is a one and two story modern steel and masonry structure which provides 155,000 sq ft of floor space.

In 1943 Edward M. Greer and Robert P. Lord joined forces to supply reliable test data for the complex range of aircraft components and accessories. Before the end of the War, the company had cre-

NEW PLANT *of Greer Hydraulics, Inc., at the New York International Airport, Jamaica, N. Y. is the first industrial building on the airport.*

CHAIRMAN *Howard S. Cullman (left) representing the Port of New York Authority, presents keys to the new plant to Robert P. Lord (center) and Edward M. Greer.*

ated, engineered and produced some thirty different types of aviation test equipment. These test units were designed to "check out" hydraulic, fuel, vacuum, propeller and other aircraft systems by subjecting them to the most rigorous simulation of actual flight conditions.

The Greer hydro-pneumatic accumulators, now widely adopted in industry, have played an important part in building the company.

Use the NEW Auto-Diesel
*LONG WEARING
Guide Rings

Single acting hydraulic cylinders were badly in need of LONG WEARING GUIDE RINGS. Auto-Diesel Engineers worked on this problem and developed a bronze ring that will give much longer service. These rings are made in sizes from 2" up to 10" in diameter and in widths from ¼" to 1½". They are priced right and we can make fast deliveries. It will pay to investigate.

Need small quantity of Piston Rings in a BIG HURRY?? Auto-Diesel can supply them at ... ATTRACTIVE PRICES

Costly production delays often result from delays in obtaining replacement piston rings. Auto-Diesel is set-up to make piston rings in small quantities and do it in a hurry. In addition to this they are sold at ATTRACTIVE PRICES. They are made up to 85" in diameter for original equipment and for placement in compressors, hydraulic cylinders, valves, etc. Write Auto-Diesel Engineers regarding any ring problem you may have.

Write for Details

THE AUTO-DIESEL PISTON RING CO.
3137 Superior Avenue • Cleveland 14, Ohio
"RINGS and SHAPES Since 1921"

First line of defense against...

S.S.WHITE
ELASTOPLASTIC
PLUGS AND CAPS

When you make an expensive part, it's good business to protect it against needless damage during shipment and storage. The way to do this – at minimum cost – is with S.S.White Elastoplastic Plugs and Caps.

These inexpensive flexible plastic closures are designed to cover or seal important openings or studs. They keep dirt and moisture out of interior parts –protect ends of tubing and studs – and seal in hydraulic fluids.

Besides being low in cost, S.S.White Elastoplastic Plugs and Caps are easily applied and removed – they're unaffected by oil, grease and gasoline and are available in a wide range of sizes for every need.

WRITE FOR BULLETIN P-5312

It has full details on S.S.White Elastoplastic Plugs and Caps. Sample plugs and caps can also be furnished on request.

THE S.S.White PLASTICS DIVISION
DENTAL MFG. CO.
Dept. L, 10 EAST 40th ST., NEW YORK 16, N. Y.
Western District Office • Times Building, Long Beach, Calif.

BUILT TO LAST...

O-M CYLINDERS
(air · hydraulic)

Designed and engineered with the user in mind, O-M Cylinders embody every essential construction and mechanical feature to assure trouble-free performance and long service.

They are built of steel with bearing surfaces of bronze—precision machined with modern equipment.

Cylinder bores are honed to a fine finish, and the hi-tensile piston rods are polished to give long life and smooth performance.

Effective O-ring static seals are backed up to prevent extrusion under high pressures. All packings are self-adjusting and are carefully selected for proper usage.

A rigid inspection at the factory is your guarantee of peak performance.

O-M Cylinders fit where others won't because O-M special interlocking mechanism eliminates bulging tie rods and end caps.

Available in a full range of sizes (1½" to 8" bores) with standard, 2 to 1 or oversize rods. *14-day delivery on most sizes.*

Write today for FREE catalog and complete set of ½ and ¼-scale templates showing all cylinders and mounting brackets.

MAIL COUPON NOW!

ORTMAN-MILLER MACHINE CO.
1204 150th Street - Hammond, Ind.

☐ Please have representative call
☐ Please send latest catalog

Name _____
Company _____
Address _____
City _____ Zone ____ State _____

Post Scripts of Industry

Two Texas branches of the **Airsco Rubber Company** have been named as distributors of synthetic rubber "O" rings by The Parker Appliance Company. B. J. Anthis, president of Airsco, said his Dallas and Fort Worth branches will maintain stocks of Parker "O" rings for customer service in the north Texas region. **Travis Tucker** manages the Dallas branch at 1039 Levee street while **Raymond Mears** manages the Fort Worth branch at 408 West Weatherford. The branches will have available the services of M. L. Sheehan, sales engineer, who is assigned to the north Texas region.

Formation of a new application engineering division within the company's engineering department is announced by **Morse Chain Company.** The new division which has been formed to meet application engineering requirements of the company's lines of overload protection devices, cam clutches and couplings, will be headed by **Ralph E. Cherry,** former executive engineer of the Morse Detroit plant. **Earl E. Wesselhoff,** has been named assistant chief engineer in charge of development, production engineering and the Detroit engineering laboratories.

NFPA Schedules Fall Meeting in New York

The 1954 Fall Meeting of the National Fluid Power Association will be held at the Hotel Commodore, New York City, on Wednesday, September 8 and Thursday, September 9. The emphasis will be placed on working sessions of product sections and committees.

In addition to the Pump, Valve and Cylinder section meetings, the three separate units of the old Accessories Section—Packings and Seals, Connectors and Conductors and Related Components will hold regular meetings. E. F. Noyes, Plastic & Rubber Products Co., is chairman and Jack Taylor, Precision Rubber Products Corp., is secretary of the Packings and Seals Section; D. A. Cameron, The Parker Appli-

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★ DETACHABLE HOSE FITTINGS

★ FLEXIBLE HOSE ASSEMBLIES

STRATOFLEX Hose Fittings and Hose Assemblies are designed to give dependable service and maximum performance. Cost-minded operators in the industry recommend STRATOFLEX! Whatever your requirements in flexible hose assemblies and detachable reusable hose fittings — or elbow hose fittings — specify STRATOFLEX!

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ance Co., is chairman and L. J. Henderson, The Weatherhead Co., is secretary of the Connectors and Conductors Section; and E. M. Greer, Greer Hydraulics, Inc., is chairman and A. E. Pearson, Sprague Engineering & Sales Corp., is secretary of the Related Components Section.

Following product sessions, industry wide committees on education, government relations, markets, engineering standards will meet.

Ben N. Ashton, President, Electrol Incorporated, is president of NFPA. Details concerning the Fall meeting may be obtained from Barrett Rogers. Executive Secretary, 1618 Orrington Ave., Evanston, Ill.

The Market Place

DISTRIBUTORS WANTED

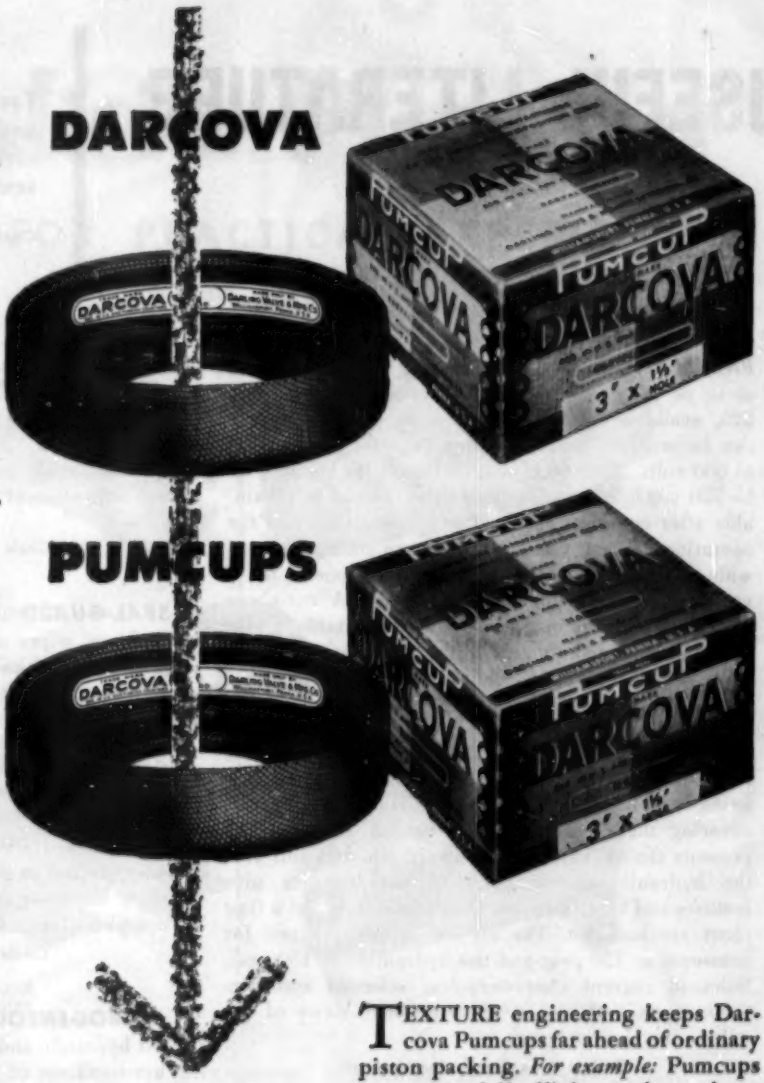
All territories open. New program. Patented "Seal-Guard" Rod Wipers. Hottest item of its kind. Easy to order. Easy to stock. Easy to sell. Write Hydraulic Accessories Co., 24301 Hoover Road, Van Dyke (Detroit) Mich.

SENIOR HYDRAULICS ENGINEER

Opportunity now available at Bendix Products in the Aircraft Landing Gear Department in the following Hydraulics activity; creative design, laboratory testing, production and inspection liaison, performance analysis, and test data plotting. Engineer must have a minimum of five years of hydraulic experience, preferably in aircraft, to work with master cylinders, power valves, hydraulic servos and pressure reducers. Please send resume to: EMPLOYMENT DEPARTMENT, BENDIX PRODUCTS DIVISION OF BENDIX AVIATION CORPORATION, 401 Bendix Drive, South Bend, Indiana.

DESIGNER WANTED

An experienced designer of Hydraulic Presses for expressing oils is required by old established manufacturers of Machinery. Applications are invited from candidates so experienced and with the highest qualifications. The principals are old established and conditions of employment accord with best modern practice Applications, which will be treated in strict confidence, should give full details of age, training, qualifications, experience and salaries earned, and should be addressed to the Design Director, Box No. 7720 c/o Charles Barker & Sons, Ltd., 31 Budge Row, E.C.4. The appointment is in the United Kingdom and this advertisement is intended for British readers of this Journal.



...famous for

- PUMPING EFFICIENCY
- LOWER COST
- LONGER SERVICE

TEXTURE engineering keeps Darcova Pumcups far ahead of ordinary piston packing. *For example:* Pumcups operate at full efficiency throughout their entire life. Fluid slippage is virtually eliminated.

Moreover, you can count on much longer service . . . users report Darcova Pumcups outlast other packing at least 3 to 1!

Write for all the facts on Darcova efficiency: Bulletin No. 4502 on Pumcups for air and hydraulic mechanisms; No. 4401 on Pumcups for reciprocating pumps.

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP
PUMCUPS

USEFUL LITERATURE

You'll find many valuable production and design ideas in publications described here . . . copies will be sent you free without obligation

Continued from page 10

PNEUMATIC TIMERS . . . Timing relays for either ac or dc power systems are discussed in bulletin No. 225, available from Square D Company. AC timers can be provided with operating coils for voltages up to 600 volts, 25 to 60 cycles, dc timers for voltages up to 250 volts. Adjustable time delay period is obtainable after energization or after deenergization of the operating magnet. Contact ratings are sufficient for a wide variety of control circuits. Many timers, for a variety of applications, are illustrated. A cut-a-way view illustrates the operation. A selection table is also included. Planned to aid in the selection of a unit when certain operating conditions are desired.

Circle 157 on Reader Service Card

AIR AND HYDRAULIC VALVES . . . Several bulletins have been issued by Beckett-Harcum Company, covering these products. Bulletin No. 101 and 102 presents the air valves and bulletin No. 103 and 104, the hydraulic valves. Each of the bulletins give features and specifications. Directional flow and a flow chart are included. The air valves are designed for pressures to 150 psig and the hydraulic for 1500 psi. Solenoid current characteristics, solenoid specifications, parts lists and a cross-sectional views of the valves are also included.

Circle 158 on Reader Service Card

TUBE WORKING TOOLS . . . Catalog No. 3011-A, available from The Imperial Brass Manufacturing Company presents many tools including cutting, flaring, bending, reaming, swedging, pinch-off and refacing. Each of these tools are completely described and illustrated. Capacities and accessory equipment available are also given. Features and operation of the tools are included.

Circle 159 on Reader Service Card

HYDRAULIC CONTROL VALVES . . . Pantex Manufacturing Corporation has released new bulletins on 100-5000 psi valves. The subject of bulletin AD is relief valves (Cartridge type unit) 350-5000 psi; bulletin 25, ¼ in directly operated 4-way valves, solenoid controlled, 100-5000 psi; bulletin 55, ¾ in pilot operated 4-way valves, solenoid controlled, 100-5000 psi; bulletin 57, ¾ in pilot operated 4-way valves, remotely controlled, 100-5000 psi. Relief valves range in size from ¼ in to ¾ in and flow rate from 3 to 20 gpm. Installation dimensions are shown for each of the sizes available. Port size of the directly operated 4-way valve is ¼ in only. Flow rate is 1¼ gpm. Complete dimensional information is given on the installation drawings. Similar information is given for both solenoid and remote controlled pilot operated valves.

Circle 160 on Reader Service Card

SEAL-GUARD . . . as a protection for hydraulic packings, wipes off dirt. How the rings remove sand, grit, paint, chips and other foreign material is described in a bulletin offered by Hydraulic Accessories Company. The metallic rod wipers are self-adjusting and have a full-floating cushion which absorbs side-thrust. In operation, the twin wiper rings are mounted on the rod with the notches staggered. The cushion ring is compressed on the assembly exerting the constant inward pressure that keeps the ring in contact with the rod at all times. Sketches are included which show the most common applications. A chart shows complete dimensions for each seal-guard.

Circle 161 on Reader Service Card

HOMOGENEOUS "V" RINGS . . . recommended for hydraulic and pneumatic applications for pressures not in excess of 5000 psi are described in an 8 page bulletin released by Raybestos-Manhattan, Inc. These "V" rings made from two types of synthetic rubber are low in friction and low swelling. Rings made using Buna-N base compound have been developed to meet the need for rings with high oil resistance but having low friction. Complete information is given on sizes available for each diameter of rod or ram. A diagram shows the method of determining the number of rings required for a flat installation. Standard sizes for homogeneous "V" packing rings are given. Also information is given on the characteristics and features. Standard sizes are available for many cylinder diameters from ½ in to 12 in.

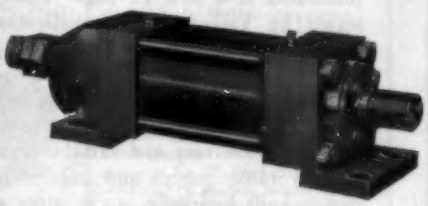
Circle 162 on Reader Service Card

PORTABLE AIR COMPRESSORS . . . developing high pressure, are described in product sheet No. 5, issued by The Cornelius Company. The 32 series has a pumping capacity of .6 cfm of free air. Will compress 25 cu ft of free air to 2500 psi in 45 minutes. The 130 series, has a pumping capacity of 2 cfm of free air. Will compress 25 cu ft of free air to 3000 psi

AUTOMATION

Realistic Planning

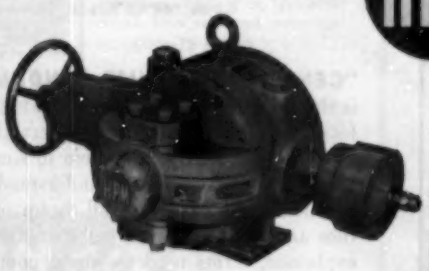
CALLS FOR PRACTICAL EXPERIENCE



AIR AND OIL
HYDRAULIC CYLINDERS

AUTOMATICALLY
CONTROLLED VALVES

HPM



VARIABLE VOLUME
HYDRAULIC PUMPS

PACKAGED POWER UNITS

For over three-quarters of a century H-P-M engineers have designed equipment — and motions — for varied requirements. Now, with a complete line of air and hydraulic components as part of our standard line you are assured of complete responsibility for your automatic systems. The hydraulic cylinders, valves, pumps and power units illustrated are typical of the air and oil hydraulic equipment in the H-P-M line. Call in the H-P-M Field Engineer in your locality when power, or the control of power, is your problem. The experience of the H-P-M organization will be of real assistance.

This 28-page condensed catalog covers the complete H-P-M line of hydraulic components. Write for your copy.

HPM

HYDRAULIC
POWER
DIVISION
THE HYDRAULIC PRESS MFG. CO.
MOUNT GILEAD, OHIO, U. S. A.
1084 MARION ROAD

A New Series

MANUALLY OPERATED
3-Way & 4-Way PILOT VALVES

Small-Rugged-Low Cost

For controlling the operation of small Air Cylinders to 3" dia. and Master Valves of any size and type.

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LEVER OPERATED VALVE

Lever is instantly reversible 180° for either direction of operation.

3-Way available normally open or normally closed.

ROLLER CAM OPERATED VALVE

Roller cam is instantly reversible 180° for either direction of cam travel.

3-Way available normally open or normally closed.

Valves in this series can be furnished for Stud or Palm Button manual operation, they are also available for solenoid control.

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SOLENOID OPERATED

3-Way 4-Way PILOT OPERATED VALVES

1/4" – 3/8"
1/2" – 3/4"
sizes

Write today for Bulletin

Automatic Valve Co.

37419 GRAND RIVER AVE.
FARMINGTON, MICHIGAN

USEFUL LITERATURE

Continued

in 15 minutes. Both series are air cooled, 3 stage design. Both have integral oil reservoirs and efficient interstage cooling.

Circle 163 on Reader Service Card

HYDRAULIC POWER AND CONTROL EQUIPMENT . . . for the textile industry is described and illustrated in a new 12 page catalog No. 54-66, released by Vickers, Inc. Specifications, performance curves and operating descriptions are given for a range of six standard models of integral hydraulic transmissions and controls, rated from ¾ to 25 hp. Specification tables are included, from several standard models of variable delivery and variable displacement piston-type hydraulic pumps and motors. The standard and custom-built hydraulic power units are described, as well as single and two stage vane type, hydraulic pumps. Circuits are included for split hydraulic transmissions and reciprocating motions. Typical textile machinery hydraulic power applications are illustrated.

Circle 164 on Reader Service Card

"CENTRIFUGAL PUMP FUNDAMENTALS" . . . is the subject of an interesting and instructive booklet, form 7287 available from Ingersoll-Rand Company. The 12 page booklet is written in simple language and is illustrated with easily understood diagrams. It is planned to be of use to all pump operators, installation and maintenance men. Principle of operation is explained, terms used in pump computations are defined, and a few typical pump problems are worked out. Some of the subjects discussed are centrifugal pump analogies; how to calculate total head of pressure capacity or quantity delivered; specific gravity or weight of liquid; hydraulic and brake horsepower and pump pressure.

Circle 165 on Reader Service Card

HYDRAULIC VALVES . . . which are solenoid operated and sub-plate mounted are described in an 8 page catalog No. 260, offered by Rivett Lathe & Grinder Inc. Featured are J.I.C. diagrams showing flow operations under all types of action for each one of the fourteen piston designs. Also highlighted are cut-a-way illustrations showing shock resistant spool design. Suitable for full 3000 psi. The spool features a scalloped design and built-in metering grooves, which permits easy and fast flow and thus reducing impact. By changing pipe tap size in sub-plate, the 1 in bore valve may be used for either ½, ¾ or 1 in, and the 1½ in basic valve for 1¼ and 1½ in.

Circle 166 on Reader Service Card

2 PIECE REUSABLE COUPLINGS . . . for one wire braid cotton cover hydraulic hose. Particularly helpful for on-the-job replacements and for emergency re-

Circle 38 on Reader Service Card

how 10 characteristics of

GAST rotary AIR MOTORS

Model 1AM Up to ¼ HP — only 2½" dia., weighs 1½ lbs.
Model 2AM Up to ½ HP — weighs approx. 5¼ lbs.
Model 4AM Up to 1 HP — only 5¾" high (less muffler).
Model 8AM Up to 4 HP — only 6½" high (less muffler).

see our catalog in
PRODUCT DESIGN FILE
or write for copy

WRITE GAST for Air Motor Bulletins. Request "Ideas" Booklet.

solve tough original equipment problems

Just one of these ten inherent advantages of Gast rotary Compressed Air Motors may solve knotty problems on your original equipment applications.

1—Low first cost. 2—Explosion-proof safety. 3—Variable speed. 4—Can't burn out from overloads or stalling. 5—Four vanes — instant starting. 6—Amazing compactness for HP. 7—Light weight —to ¼ of electric motor. 8—Smooth rotary-vane ball-bearing performance. 9—Reversible models. 10—Dependability for long service.

Now standard equipment on many products. Four sizes, many design variations. Vertical or horizontal drives; base or flange mountings. INVESTIGATE NOW!

Original Equipment Manufacturers for Over 25 Years

GAST ROTARY — AIR MOTORS • COMPRESSORS • VACUUM PUMPS
(TO 4 H.P.) (TO 30 LBS.) (TO 28 INCHES)
GAST MANUFACTURING CORP., 131 Hinkley St., Benton Harbor, Mich.

MODERN air fluid POWER

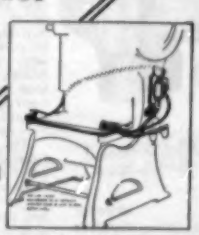
POWER MACHINE CONTROL

OPERATOR FATIGUE REDUCED

SINGLE ACTION SAFETY CONTROL

HAZARDOUS OPERATION ELIMINATED

MACHINE PRODUCTION INCREASED



CYLINDERS
CONTROL VALVES
PILOT VALVES

All components required for complete automatic and sequence circuits:

Engineering of control circuits

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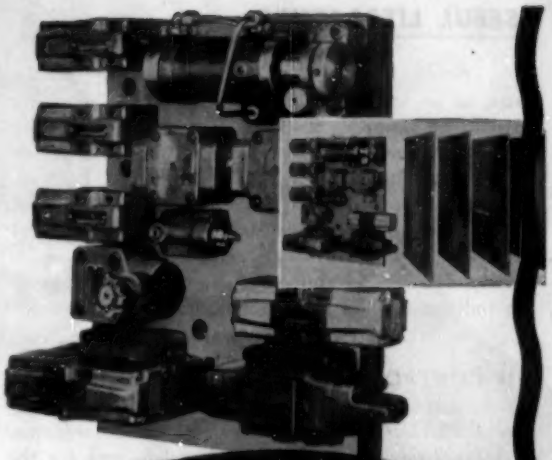
STOCKS IN PRINCIPAL CITIES

Modernair CORPORATION



ALMO
HYDRAULIC CONTROL MANIFOLDS

CONTROL SYSTEMS READY FOR OPERATION—NO CIRCUITS TO PONDER OVER AT INSTALLATION

Leading machine manufacturers use these manifolds to cut costs and obtain permanent trouble-free operation. Send your hydraulic circuit print and sketch showing desired take-off connections. We'll prepare a manifold proposal—No obligation.

ALMO TOOL COMPANY
11470 Kaltz—Centerline, Mich.

"Design Wise"

Colonial Broach Co. uses an Almo manifold in this 15 ton capacity, 66" stroke dual-ram broaching machine.

Circle 61 on Reader Service Card

Circle 7 on Reader Service Card

USEFUL LITERATURE

pairs, as no special tools are needed. Hose does not have to be stripped, just inserted into the coupling body. Four operations are required to make a proper installation. Bulletin No. 105, released by Eastman Manufacturing Company, shows how this is done, step by step. The various coupling catalog numbers are listed in a chart which gives thread sizes, hose catalog number, id and od of hose, minimum bending radii, maximum psi and maximum burst pressure.

Circle 167 on Reader Service Card

AIR CONTROL VALVES . . . A 66 page catalog completely describing the line of Airmatic Valve, Inc., is now available. The catalog gives all pertinent information for 2-way, 3-way and 4-way valves and for the following types: cam, flow control, foot, hand, interlock, pilot, pressure regulator, quick exhaust, sequence, solenoid, and time delay. Also presented are air and hydraulic cylinders. Information on size, pressures, features, applications, parts lists, mounting dimensions and cross-sectional views are given for each valve presented. Similar data is given for the cylinders.

Circle 168 on Reader Service Card

HYDRAULIC CYLINDERS . . . for pressures up to 3000 psi are presented in catalog No. 741 released by Hydraulic Power Division, The Hydraulic Press Mfg. Company. The catalog is very complete and covers all material thoroughly. Each cylinder series is handled separately and includes the same information. Many different mountings are illustrated and dimensioned for installation purposes. Features and cut-a-way view of the cylinder are included. Other subjects discussed are single acting cylinders, telescoping cylinders, large bore cylinders, special cylinders, accessories and capacities.

Circle 169 on Reader Service Card

CUSTOM MOLDED ARTS . . . including thermolastic and synthetic rubber "O" rings, Teflon "O" rings, Teflon back-up rings and hydraulic packings are described in a two color, 24 page illustrated catalog. Permadizing a rubber-to-metal bonding process, is discussed and the company's new packaging method for sealing "O" rings in individual wrappings is outlined. Engineering and design information, includes service recommendations, dimensional data for installation usage. Write to Stillman Rubber Company.

Circle 170 on Reader Service Card

EXTREME PRESSURE LUBRICANT . . . is a lithium base product containing Molykote molybdenum disulphide powder. Bulletin 101, prepared by The Alpha Corp. carries the specifications covering the lubricant and prices. The lubricant is suitable for use in highly-loaded ball and roller bearings and on heavily-loaded sliding friction surfaces. It is oxidation inhibited and has an operating temperature range from –30 F. to 350 F. The bulletin is in two colors and contains interesting information concerning the product.

Circle 171 on Reader Service Card

★ONLY THREE PARTS
★MEETS J.I.C. STANDARDS
★GREATER FILTERING AREA
★SPECIAL TRAP-WEAVE MESH

The New
CAPITAL HYDRAULIC OIL FILTER
WITH MONEL METAL INSERT
Reservoir Type for Hydraulic and Oil Re-Circulating Machinery
EASY TO INSTALL • EASY TO CLEAN • LONG LIFE • LOW COST
SIZES AND SCREENS TO FIT YOUR NEEDS

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Circle 21 on Reader Service Card

NOW!
PRODUCE
A.N.D. 10050
PORT CONTOURS
3 TIMES FASTER!

The new Sonnet Port Contour Cutter completes all five operations in one pass!

Chamfering, counterboring, radiusing, countersinking, spot facing...all five are necessary to produce the A.N.D. 10050 port contour or connecting hole. Now, with Sonnet's new four-fluted, special-purpose contour cutter, all five operations can be completed with a single pass, *reducing job time as much as two-thirds!*

The new cutter is made from alloy steel and hardened for toughness. Carbide tips on all four flutes assure longer cutting life and smoother finish. Available in all sizes with integral or replaceable pilots.

Write for descriptive literature and prices today

Sonnet TOOL AND MFG. CO.
574 No. Prairie Avenue, Hawthorne, California
Specialists in carbide and high speed steel cutting tools

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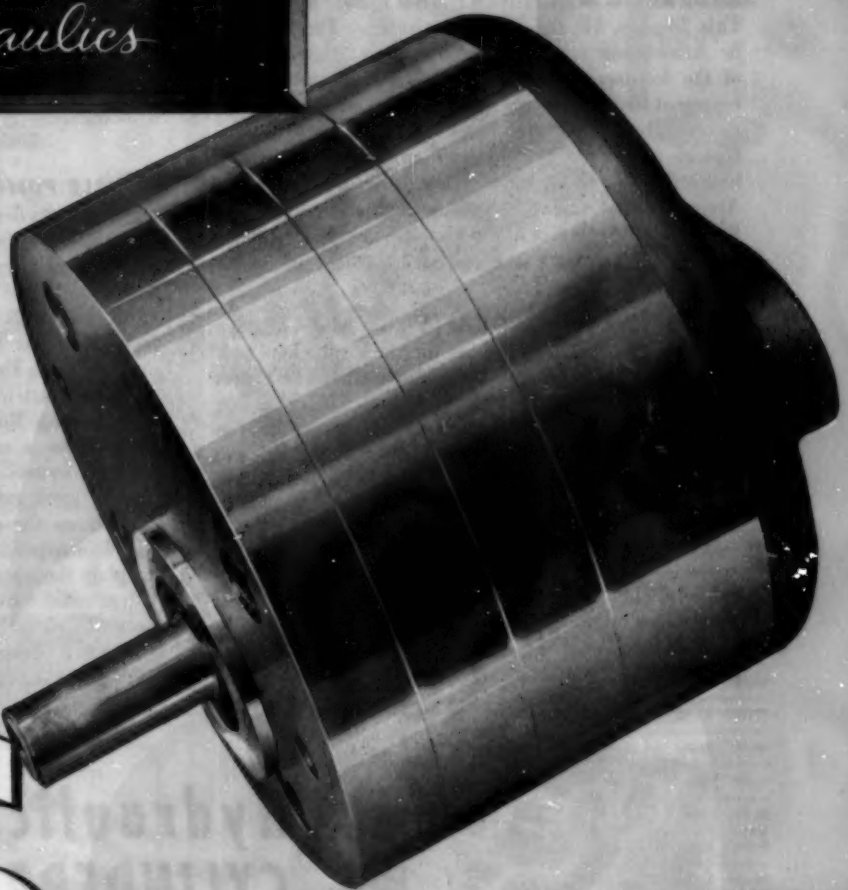
Circle 52 on Reader Service Card →

Keelavite hydraulics



FROM 6 BASIC DESIGNS...

... a complete range of hydraulic power transmission units from fractional to 250 h.p.

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CYLINDERS · TRANSMISSIONS · REMOTE CONTROLS

THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

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USEFUL LITERATURE

HYDRAULIC MACHINERY AND EQUIPMENT . . . This 28-page, file size booklet, issued by The Hydraulic Association contains a check list of the products of the fourteen member firms. Many of these firms represent over a century of experience in the development of hydraulic equipment. Both components and typical machines, presses and equipment to which hydraulic systems are applied, are listed. The Hydraulic Association of Great Britain is a group of leading British manufacturers in the hydraulic equipment field.

Circle 172 on Reader Service Card

ROLLER CHAIN SPROCKETS . . . A new 8 page catalog No. C56-54, describing the stock sprockets now available may be secured from Morse Chain Co. Sizes and prices are given for ½, ⅝, ¾, 1, 1¼, 1½, 1¾ and 2 in pitch Type B, stock sprockets with a hub on one side. Similar information is given for 1½, 1¾ and 2 in pitch Type C sprockets, with a hub on both sides. Installation and removal instructions are included.

Circle 173 on Reader Service Card

HYDRAULIC SERVO ACTUATOR . . . offers control system engineers a packaged, linear actuator with good performance. Technical bulletin No. 116-A prepared by Pegasus Laboratories, is an 8 page bulletin completely describing the operation and characteristics of the unit. Many diagrams such as typical test circuit block diagram, actuator phase lag, actuator transfer function, and differential current output rate vs input current are included. A hydraulic servo transmission system designed to provide remote position control for test facilities, remote manipulation, process control are also included together with installation drawings.

Circle 174 on Reader Service Card

DOUBLE PUMPS WITH VALVE PANELS . . . are integral units designed to meet demands for fluid power at 2000 psi for the operation of circuits calling for a substantial variation in pump volume as during "close and hold" or "traverse and feed" cycles. Bulletin No. DP-308, released by Dudco Division, The New York Air Brake Company, describes the design and features. Unit consists of two standard 2000 psi pumping cartridge assemblies within a single compact housing. Both cartridges are driven by a common shaft, have a common inlet but discharge through separate outlets. Cartridges have capacities of 3, 5, 8, and 11 gpm, rated at 1200 rpm. Valve panels mount directly on the discharge ports of the double pumps. Panel incorporates the auxiliary controls necessary to regulate the output of both pumping cartridges, check valve, relief valve, unloading valves. Fluid power can be supplied either to two separate systems or to a single two pressure circuit, controlled automatically.

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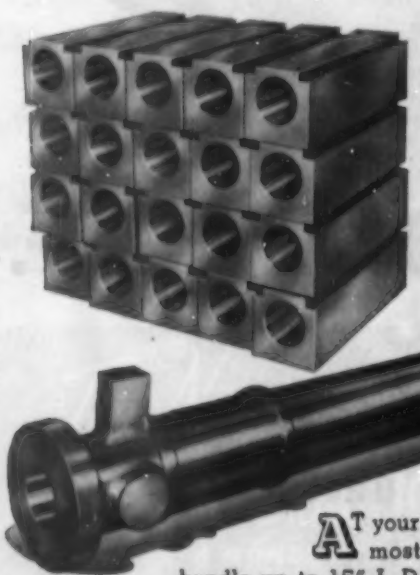

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Circle 1 on Reader Service Card

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Three types; pressures to 1500 lbs. For details send for

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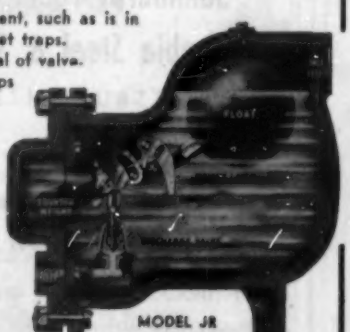

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2½"	32.36	34.12	34.68	35.24	36.36	37.48	38.60	39.72	41.40
3"	35.04	37.28	37.92	38.56	39.84	41.12	42.40	43.68	45.60
4"	40.84	43.68	44.52	45.36	47.04	48.72	50.40	52.08	54.60
4½"	48.96	51.92	52.88	53.84	55.76	57.68	59.60	61.52	64.40
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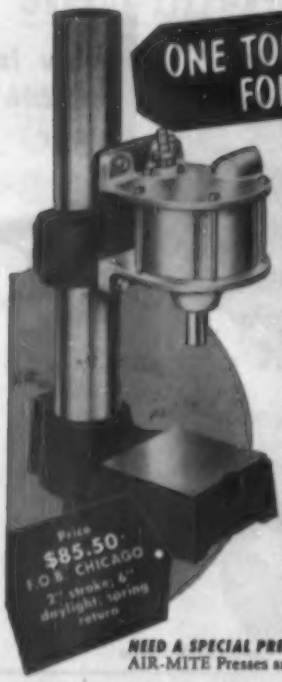

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USEFUL LITERATURE

Continued

HYDRAULIC CYLINDERS . . . for low pressures are presented in a 4 page folder released by Rotex Punch Co., Inc. Available in bore sizes of 1⅛, 2, 3 and 4 in bores, they are supplied in non-cushioned and cushioned models. The cushioned model is not available in 1⅛ in size. Complete mounting data is given for the standard size cylinders. Six mountings are illustrated, base, foot, flange, pivot, clevis and nose. Installation data is given for each of them. A chart shows the load capacity of cylinders, for various pressures.

Circle 184 on Reader Service Card

HEAVY DUTY AIR COMPRESSORS . . . Joy Manufacturing Company has released a new 36 page bulletin A-72 on compressors for industry. The bulletin contains complete information on construction and operation of the compressor. Illustrated are seven models; as a single unit for displacement capacities from 1186 to 1948 cfm, as well as twin units which furnish up to 3896 cfm. The two stage compressor is double acting and has a four cylinder semi-radial design. Available with flange-mounted, V-belt or direct connected drives. Features of the units are presented which include replaceable crosshead, cylinder liners and full force-feed lubrication.

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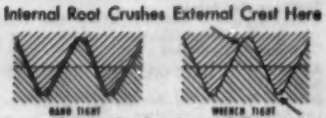

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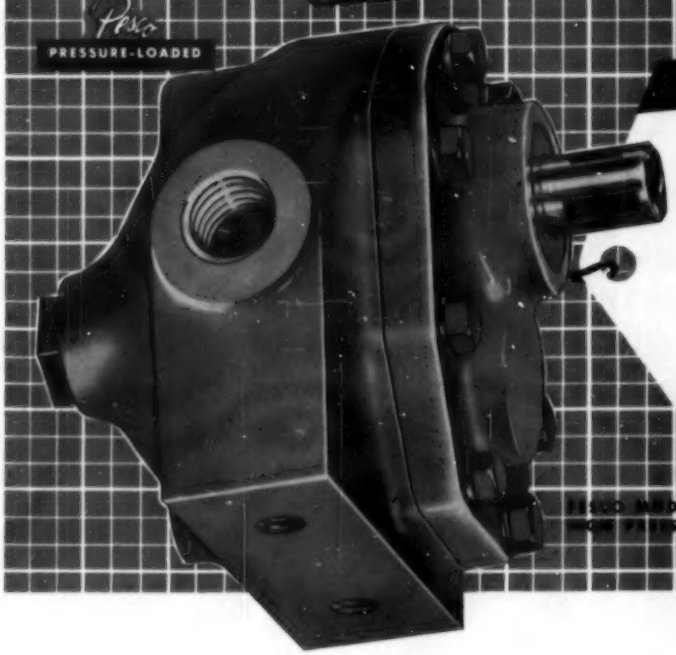

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